



PROJECT CONTROLS REPORT



December 15, 2008

*Submitted by the Accelerated Bridge Oversight Council pursuant to
Section 17 of Chapter 233 of the Acts of 2008*

Respectfully submitted by the Structurally Deficient Bridge Improvement Program Coordination and Oversight Council to the chairs of the Joint Committee on Transportation, the Joint Committee on Bonding, Capital Expenditures and State Assets and the House and Senate Committees on Ways and Means, pursuant to section 17 of chapter 233 of the Acts of 2008.

ACCELERATED BRIDGE PROGRAM PROJECT CONTROLS

EXECUTIVE SUMMARY

In May 2008, Governor Deval Patrick introduced the \$3 billion Accelerated Bridge Program (ABP) to reduce the Commonwealth's growing backlog of structurally deficient bridges. The Accelerated Bridge Program will dramatically improve the health of Massachusetts bridges and create thousands of jobs. At the same time, taxpayer dollars will be efficiently spent, eliminating or reducing construction cost inflation and the expensive deterioration that comes with time. By completing projects sooner, the Commonwealth will avoid losing critical dollars to inflation. To ensure the goals of the program are achieved, new program and project controls are being implemented by the Massachusetts Highway Department (MassHighway), the Department of Conservation and Recreation (DCR) (collectively, the "Agencies") and the Oversight Council charged with coordinating the program. This report describes the state-of-the-art cost, schedule, and quality management practices that will govern this program. The intense focus on streamlining project delivery, adoption of innovative design, construction, and project management techniques promise to make the Accelerated Bridge Program a transformative initiative that will yield far-reaching improvements extending beyond the next eight years and across state government.

Central to the mission of the Accelerated Bridge Program is the requirement for transparency and accountability in all aspects of program management. As a result, cost and schedule controls will go beyond minimum industry standards for project delivery and include an ongoing focus on public reporting. Chapter 233 of the Acts of 2008, which authorizes the Accelerated Bridge Program, specifically requires the implementation of effective project controls to ensure adequate tracking and reporting of program progress, cost and schedule. The controls described in this report will themselves be continuously improved so that over the next eight years, the controls and reports will evolve to meet the challenges presented. The data and reports generated through these controls will guide critical program management decisions aimed at delivering projects on-time and on-budget and provide the public a clear view of the work performed and the Commonwealth's return on investment.

The Program Controls described in this report were developed over the past several weeks and are based on a review of best practices from other state programs, agency expertise, industry best practices and were prepared with the goal of meeting the public reporting requirements for the program. MassHighway contracted with Keville Enterprises, Inc. (KEI), to review current agency internal practices and recommend

improvements to such practices with regards to the on-time, on-budget provisions of the Accelerated Bridge legislation. KEI published dozens of cost and schedule options in a draft report dated November 1, 2008. In order to address the volume and complexity of the report, three working groups were assembled to address three categories of observations and recommendations.

1. Project Controls – Design Schedule
2. Project Controls – Construction Schedule
3. Project Controls – Budget and Cost

The three working groups were comprised of MassHighway staff that is intimately knowledgeable in the current operations and procedures of MassHighway. A representative of DCR participated in each working group and a representative of KEI served as the facilitator. The ABP management team empowered these individuals to carefully investigate, assess and debate the options in the draft report. Each working group was tasked with the development of a list of cost and schedule recommendations or control measures to adopt.

The cost and schedule recommendations were classified into four categories:

- Recommendation(s) already being practiced by the Agencies.
- Recommendation(s) that mirrored current practices with modifications or improvements.
- Recommendation(s) that were not being practiced by both Agencies, but should be adopted.
- Recommendation(s) had some merit but required further information or review.

The working groups completed their tasks by November 24, 2008. Final recommendations were approved by ABP senior management for inclusion in this Project Controls Report.

It is important to note that the control and reporting requirements contained in the legislation are extremely aggressive, requiring reporting of detailed project level cost and schedule information very early in the program, and generally establishing a goal that at least ninety percent of the bridges in the ABP will be completed on time and on budget. Every effort has been made to meet these requirements while also delivering the program in an effective and business-like manner. Best management practices dictate that successful performance measurement begins with well-structured goals based on accurate data and assumptions. Inherent to the construction process is the refining of data and assumptions as projects are scoped and design progresses. Project delivery goals to be used for performance management are therefore more accurately set at the point of 75% complete design. Continuous monitoring and reporting throughout the program will reflect both the progress that is being made and the level of confidence to be accorded project goals for cost and schedule.

This report is divided into four major sections: 1. Cost Control; 2. Schedule Control; 3. Construction Quality; and 4. Implementation. Each of these sections contains specific recommended project control measures for implementation on the ABP. Some of the measures should be implemented at the project level, and some should be implemented at the program level. When fully implemented, as a whole, these integrated measures will provide a project controls system that will allow for effective cost and schedule monitoring, control, and reporting on the ABP.

COST CONTROL

Section 1 of this Report, Cost Control, provides recommended cost control measures. These cost control measures are categorized as: Budget and Reporting; Program Cost Control; Construction Cost Estimating; and Contract Cost Management measures.

Budget Control & Reporting

A program as large as the ABP must have cost control measures in place to enable the development of realistic project and program level budgets, and to effectively monitor and control those budgets. This report recommends specific control measures that, when implemented, will meet this requirement. These specific measures include guidelines for:

- developing realistic budgets;
- monitoring and controlling budgets;
- developing budget reports that will meet the reporting requirements of Chapter 233 of the Acts of 2008;
- developing and monitoring key budget performance indicators;
- implementing a cost control software system to enhance budget control capabilities;
- detecting budgetary trends;
- routine periodic review of key budgetary issues; and
- implementing a monthly budget status reporting system.

Achievement of these measures will provide the Agencies with an effective budget control and reporting system for the ABP.

Program Cost Control

One of the primary goals of the ABP will be to satisfy the legislative requirement to ensure that at least 90 per cent of bridges expected to be completed in years 2009 to 2011 are completed on-time and on-budget. This report provides recommended cost control measures which, when implemented, will support the achievement of this goal. These recommended measures include guidelines for:

- cost containment initiatives;
- the use of peer reviews to control cost and schedule;
- quarterly project management public briefings to foster transparency;

- internal monthly program control meetings;
- identifying and monitoring areas of potential cost growth;
- forecasting potential cost growth associated with change orders and claims;
- estimating and monitoring program overhead costs;
- implementing a design-to-cost program;
- incorporating federal agency guidelines for accounting for cost contingencies;
- accounting for cost escalation;
- developing program level cost contingencies;
- developing contract level cost contingencies;
- monitoring and accounting for market price fluctuations; and
- recognizing and avoiding potential schedule delays and their associated costs.

Construction Cost Estimating

Generating reliable and accurate cost estimates throughout the entire cycle of the Accelerated Bridge Program is vital to the Program's Cost Control Program. All construction cost estimates for Accelerated Bridge Program projects must be developed in a consistent and systematic manner. This report provides specific guidelines for developing structured construction cost estimates, as well as cost estimating quality control and quality assurance procedures.

The most effective approach to cost estimating is to develop estimates that are based on the way that the project will be constructed, otherwise referred to as "bottoms-up" cost estimating. This involves developing the crews, equipment, and production rates that would be used to construct the project and developing the estimate based on this information. This approach to cost estimating results in an estimate that reflects a buildable approach to the work, while at the same time building in a constructability check. Another benefit of this approach to cost estimating is that the crew, equipment, and production rate information that is developed can be easily translated into a project construction schedule that is integrated with the cost estimate. This early linking of project cost and project schedule fosters effective cost and schedule control throughout the life of the project. This bottoms-up approach to cost estimating will be used on all ABP projects.

Contract Cost Management

In addition to specific cost management and control measures at the program level, effective management and control of costs will require specific measures at the individual project contract level as well. Accordingly, several measures which have proven to be effective in the industry must be implemented on each ABP project contract. These measures include Constructability Reviews, Claims Avoidance Reviews, Contract Trending, and effective Contract Administration. This report contains recommended procedures for each of these measures. When combined, all of these measures will allow the Program to optimize management and control of costs at the project contract level.

SCHEDULE CONTROL

Section 2 of this Report, Schedule Control, provides recommended Schedule Control measures. Effective schedule control includes control of design schedules, construction schedules, and the program level schedule. Design and construction schedules must be developed to accurately reflect the true durations of design and construction activities on each project, so that when they are rolled up to the Program level, the ABP schedule accurately reflects the true status of the Program. It is also imperative to include clear scheduling requirements in the specifications of both design contracts and construction contracts, and to ensure that these design and construction scheduling requirements are well coordinated. This Report provides recommended measures for schedule control which, when implemented, will provide a sound schedule control system for the ABP. The recommended schedule control measures include: design phase schedule control; contract time determination; and construction schedule control.

Design Phase Schedule Control

The ABP will require each designer to develop a detailed design schedule that will be used to monitor and track design progress; critical design tasks; critical decision dates; and critical actions required by all parties involved in the design process. In addition to the requirement for design schedules, this report provides recommended measures which, when implemented, will enhance the control of design schedules. These measures include:

- earned value reporting;
- incorporation of key design schedule activities and milestones; and
- monthly design schedule status reports.

CPM Schedule Mandate

The Agencies will mandate the use of qualified construction schedulers to prepare construction schedules. It will be the responsibility of every designer of contracts greater than \$1 Million to use a qualified construction scheduler to develop a CPM construction schedule during the design phase of each ABP project. Designers will also be required to ensure that all CPM Schedules are coordinated with the construction cost estimate for their project. This report also contains a quality control plan that will be applied to every CPM Schedule.

The ABP will also use Design-Build (DB) contracts on ABP projects where appropriate, in order to minimize project schedules and project costs. Design-Bid-Build (DBB) has historically been the routine project delivery method used for MassHighway and DCR projects. It is commonly accepted in the design and construction industry that using the Design-Build (DB) project delivery method will result in shorter project duration than if the DBB project delivery method is used, primarily because construction can begin prior to design completion. Shorter project durations can reduce duration of project overhead and general condition costs, as well as reduced cost escalation over time. Moreover, quality improves because the construction company that is actually building the project can provide direct constructability input during the design process.

Construction Schedule Control

Effective schedule control on the nearly \$3 Billion Accelerated Bridge Program has enormous cost ramifications. Prolonged schedule durations translate to increased internal program costs, increased construction and design overheads, and construction cost escalation. Accordingly, effective schedule control measures are critical to the success of the ABP. This report contains recommendations on specific schedule control measures which, when implemented, will provide an effective schedule control system. Recommended measures include:

- best practices for managing construction schedules;
- effective use of the Integrated Project Schedule at the program level;
- mandatory CPM schedule requirements for construction contractors;
- the use of state-of-the-art scheduling software;
- incorporation of scheduling requirements in construction contract specifications;
- tying construction progress payments to the construction schedule;
- use of Critical Action Reports;
- schedule recovery work sessions;
- use of a schedule quality control plan;
- developing logical and realistic schedule contingency; and
- identification of issues that could potentially cause schedule delays.

CONSTRUCTION QUALITY

Section 3 of this report, Construction Quality, provides recommended measures to control the quality of construction. Poor quality construction can lead to re-work and disputes, which typically translate to additional costs and schedule delays. In order to manage and control the quality of construction, it is imperative to implement formal construction quality control and quality assurance programs and procedures. The program will develop and implement a formal Construction Quality Control & Quality Assurance program that will be followed on all Accelerated Bridge Program construction contracts. All ABP construction contracts will contain a standardized Contractor Quality Control specification, tailored to the specific requirements and complexities of each individual construction contract. The Program will also develop a standard Construction Quality Assurance program and approach that will be implemented on all ABP construction contracts.

IMPLEMENTATION

A dedicated Project Controls organization is required to develop, implement, and maintain effective project controls on the Accelerated Bridge Program. The Project Controls organization must focus its efforts solely on control and reporting functions, and report project and program status in an objective and factual manner without influence

from planning, design, construction, operations, finance, or other organizations within the ABP. The Project Controls organization must be staffed adequately in order to ensure effective control of program and project costs and schedules.

In addition to establishing the Project Controls Organization, over the next few months, the Agencies will focus on the following aspects of the Program Controls plan:

- Implement the Software Control Systems recommended in this Report;
- Staff the Project Controls organization;
- Amend standard design and construction contracts to reflect new requirements;
- Establish the training programs recommended in this Report; and
- Establish the Early Risk Task Force recommended in this Report.

All of the control measures implemented will be done with the goal of maintaining transparency and public access to the status of the ABP program and projects. In light of this goal, a visual web-based status tool will be created. This tool will provide instant project status information to Oversight Committee members, community groups, legislators, municipalities, and the general public. Since this tool will provide an aerial visualization of each bridge and its surroundings, it can also be used for construction planning and public outreach.

By law, the Legislature will receive bi-annual reports of the updates to program controls.

SECTION 1 - COST CONTROL

1.A BUDGET AND REPORTING

1.A.0 –Introduction

Quality procedures for project control and record keeping are indispensable tools for Program management and project teams during the planning and execution of a large project such as the Accelerated Bridge Program. These tools serve the dual purpose of recording the financial transactions that occur and giving managers an indication of the progress and problems associated with the project. Cost and schedule management produce a positive outcome when it effectively aligns the demands of the project objectives, legislative and public expectations, and fiscal prudence.

The Massachusetts Highway Department (MassHighway) and the Department of Conservation and Recreation (DCR) (collectively, the “Agencies”) will implement a cost management program that develops and maintains a program budget and a construction management system. The Agencies will fulfill the reporting requirements of Chapter 233 of the Acts of 2008 and set up a multi-tiered reporting approach so all stakeholders of the ABP can access the information they need.

1.A.1 – Reporting Goals

With the assistance of Keville Enterprises, Inc., a nationally recognized leader in project control development and implementation, the Agencies have developed recommended best practices to fulfill the reporting requirements outlined in Chapter 233 of the Acts of 2008, as well as mechanisms to track program and project costs internally. The specific details of the reporting elements will be developed and implemented in the next few months. The reporting program will both manage the budget such that the overall program (as well as each project) is within the allocated Program budget and will allow all stakeholders to have access to up-to-date and accurate project schedule and budget information in a number of formats.

In order to implement this Program, the Agencies will set up a multi-tiered reporting approach. Performance tracking indicators, including but not limited to those identified in Chapter 233, will be identified and will become the basis for the data presented in ABP reports. Monthly, quarterly and semi-annual reports generated will be periodically reviewed with program stakeholders to ensure that all required data is being captured and presented in a concise and clear format. In addition, the Program will use a web-based reporting tool that will allow anyone to use the internet to find up-to-date information on the status of each bridge project as well as the Program as a whole.

1.A.2 – Performance Tracking Indicators

The Agencies will initiate a formal Performance Tracking Indicator (PTI) program for portions of the legislative reporting requirements.

Because many of the ABP projects are in the conceptual stage, performance indicators provided this year (2009) will not be based upon solid advanced designs. For many projects, not enough scope definition, quantitative information (plans and documents to provide pricing), or detailed/adequate costs or schedule assessments have yet been developed. Because of the early stages of design, cost and construction schedule information is very preliminary and should not be used at this point to control contract budgets without sufficient contingencies.

Therefore, it is recommended that:

1. The Performance Indicators include an appropriate amount of cost and time contingencies (see Sections 1.C below).
2. Designers and Engineers who work for the ABP Program do so as part of a Designer performance review program that will maintain a high level of accountability for elements within their control, while promoting a ‘team’ approach (see Section 1.B.10 below).
3. Because of limited scope definition in the early stages of design (i.e.) Structural submission is not complete until the 75%), internal performance monitoring will be established after the 75% construction estimate and schedule are developed and agreed to. **This will be the Program definition of “90% on-time/on-budget.”**

The goals of the PTI Program are to:

1. Produce measurable/realistic goals for the important stages of design and construction.
2. Comply with legislative reporting requirements in a visible manner.
3. Ensure a high degree of accountability for elements of work that the Designer/Engineer can control during the later stages of the design process.
4. Allow ample time to properly scope and budget each individual contract – before budget tracking is fully committed.
5. Reasonably identify program cost components that are within the control of the Program’s management team while separating all volatile cost components that

are outside of the Agencies' responsibility, but must be budgeted for as part of this ABP, and do so in a transparent and auditable manner.

Examples of volatile costs outside the Agencies' control include:

- a. Major commodity pricing fluctuations
 - b. General pricing escalation
 - c. Scope changes unrelated to the original intent of the ABP
 - d. Fuel cost increases
 - e. Funding delays
 - f. Major construction delays beyond the control of the contractor and the Agencies ("force majeure")
 - g. Major unknown environmental impacts and/or permitting issues
- 6. Promote transparency and 'reality' of the true cost of construction, including construction contingency and the cost of escalation (see Section 1.B.10 - escalation).
 - 7. Allow for more refined budgeting of unknowns and delays (beyond contingency and escalation).
 - 8. Allow ample time to take corrective action during the design and/or construction phase of any one particular/problematic contract.

Recommended Performance Tracking Indicators (PTI)

The following PTIs are expected to be included in the Reporting Program for all projects involving rehabilitation or replacement of a specific bridge:

1. Specific Bridge Cost Estimates (responsibility) *

- a. Contract Specific Design Budget – before selection (*MassHighway/DCR*)
- b. Contract Specific Design Budget - after selection (*Designer*)
- c. 25% Design Stage - Construction Cost Estimate (*Designer*)
- d. 75% Design Stage ** - Construction Cost Estimate (*Designer*)
- e. 100% Design Stage - Construction Cost Estimate (*Designer*)
- f. Engineer's Estimate – Bid Value (*Designer*)
- g. Contractor – Bid Value (*Contractor*)

2. Specific Bridge Scope of Work(s) – for various phases

3. PTI Milestones – Schedule Dates

- a. Submittal of 25% Design (*Designer*)
- b. Submittal of 75% Design (*Designer*)
- c. Approval of 100% Design (*Designer*)
- d. Approved Permitting & Right-of-Way Takings Complete (*MassHighway/DCR*)
- e. Date of Work Advertising (*Designer & MassHighway/DCR*)

- f. Contractor Notice to Proceed (*Designer & MassHighway/DCR*)
- g. Relevant Interim Construction Milestones (*see page 46*)
- h. Substantially Complete (*Contractor & MasHighway/DCR*)

* *Similar Indicators for Design-Bid-Build*

** *Control Estimate – for Designer performance monitoring*

Important Note: Because of limited scope definition in the early stages of design (i.e. Structural submission is not complete until the 75%), performance measurement will be established after the 75% construction estimate and schedule are developed and agreed to. This will be the Program definition of “90% on-time/on-budget.”

Recommended contingency - part of the above Performance Tracking Indicators (contract specific only)

As delineated in Section 1-B “Contract Contingency,” an appropriate amount of cost contingency (design, construction, claims), escalation, and time contingency (schedule delays) will be included in the formal definition of “on time and on budget.”

1.A.3 – Proprietary Contract Management Software

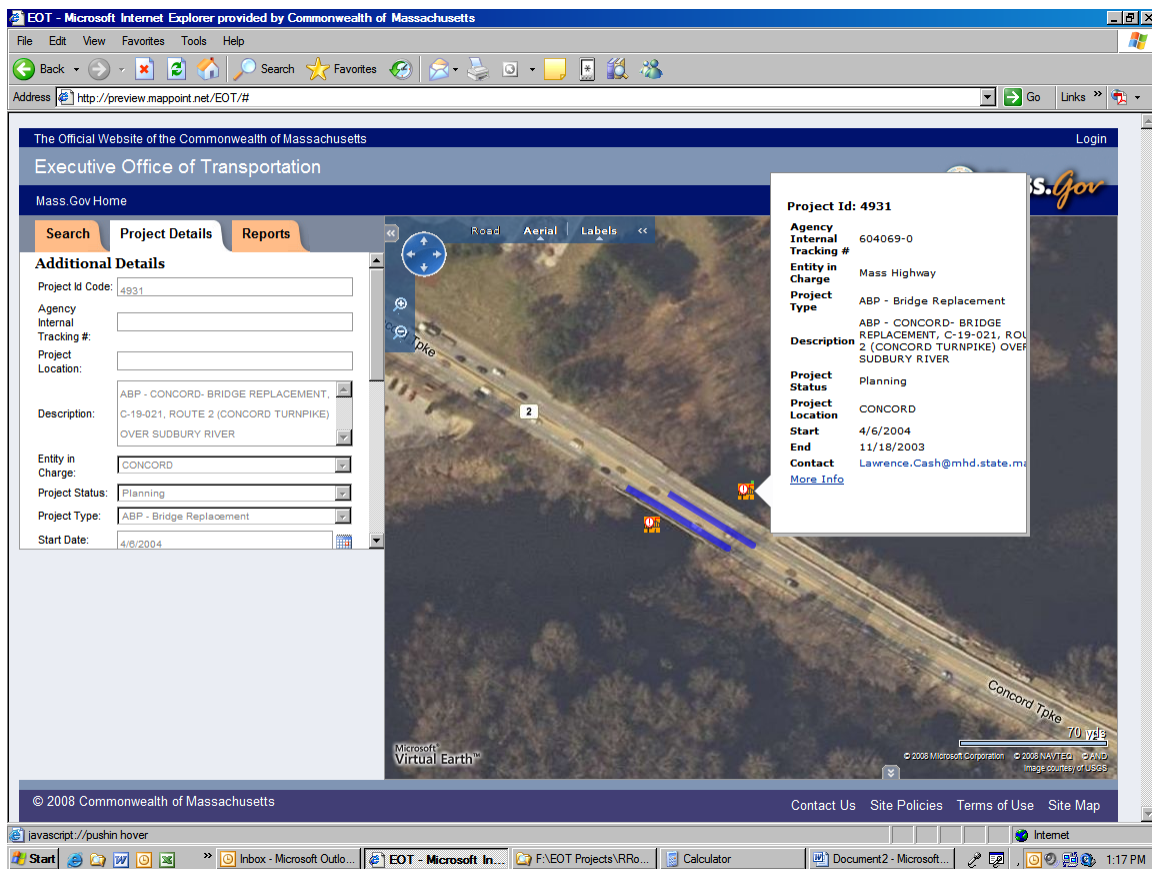
The Agencies intend to evaluate over the next several months whether proprietary contract management software should be utilized for the Program. The evaluation will include a comparison of features to the current project management software systems utilized by both Agencies as well as cost, training and delay considerations caused by technical difficulties that come from with adoption by two agencies.

1. A.4 – Visual Web-Based Aerial Status Tool

The Agencies will also adopt a unified web-based visual status tool to assist with project status reporting and transparency. This tool currently under development, will be utilized to help answer the many questions from Legislators, community groups, municipalities, and the general public, including:

- What bridges have been committed to the program?
- When will construction start the bridge start?
- How much is the construction budget for the bridge?
- Which bridges are preservation projects vs. reconstruction?
- Where are these bridges?
- What is the current status of the repair?
- What streets are impacted by construction?
- Who can I call with comments or question about the bridge?

The following is a sample of the page from web-based information tool being developed:



1.A.5 – Program Level Trending

One of the keys to successfully completing the Accelerated Bridge Program is to recognize potential problems along the way before they become issues. By analyzing patterns of construction and cost expenditures, trends (both positive and negative) can be determined. By discerning these trends early on in the process, the Agencies can avoid or alleviate probable impacts and can steer events towards successful conclusions.

As part of the program, work will be continuously monitored for new and changing risks / opportunities. Areas addressed will include safety, cost, schedule and other areas of concern. This will be done, on a case-by-case basis (on the more critical/larger aspects of the Program performance), to determine if program assumptions remain valid, risk levels are changing, policies and procedures are being followed so that contingencies will be modified accordingly. This analytical technique will be used to monitor and forecast future outcomes based on both historical data and current project results to date. The Agencies will analyze variances from either a baseline budget or a baseline schedule. By using prior progress reporting periods' data and projecting the possible variance from baseline at some future point in the program, corrective actions can be taken and impacts can be mitigated.

The following steps will be implemented:

1. Program Performance Indicators (PPIs) will be established for major portions of the ABP Program.
2. Variances against these PPIs will be reported quarterly.
3. Mitigation plans will be formulated and executed to alleviate potential problems.

1.A.6 Semi-Annual Report to Legislature (C. 233, §16)

Section 16 of the Accelerated Bridge Legislation mandates that a report be filed with the Legislature on June 30 and December 31 of each year of the Program that includes the information listed below. The report will be prepared using the Performance Tracking Indicators described in Section 1.A.2 and other information as required.

SECTION 16 The report shall include, but not be limited to: the total amount appropriated for each project, the total estimated cost of each project, the amount expended for the planning and design of each project up to the time the report is filed, the amount expended on construction of each project up to the time the report is filed, the timeline from advertisement through contract award and from the start of actual design and construction by the design build team to project completion, the time saved, if any, by employing the design build procurement method; and whether, in the opinion of the council with consultation from the commissioner of highways, design build was an effective procurement method for each project; the total amount currently expended on each project, the estimated lifetime maintenance schedule and cost of each project, the original estimated completion date of each project and the current anticipated completion date of each project. This report shall also include the total number of employees and outside contractors and amount expended on salaries and benefits for employees and outside contractors that are specifically working on projects to be carried out as part of the accelerated bridge repair program. . . .

1.A.7 – Program Management Quarterly Report

To support the legislative reporting requirements and internal controls, the Agencies will prepare a Program Management Quarterly Report.

The main objective of this report/public presentation will be to:

1. Inform the public of the current status of bridge repair.
2. Provide an explanation of *key issues* – those elements of design, construction, procurement, funding, traffic, etc. that are important elements of the ABP.

3. Provide an overall financial briefing – addressing funding status and elements in the proposed PMQ summary below.

\$ Millions						
	MHD Budget	Potential Forecast	Committed To Date	Committed To-Go	Authorized Invoices To Date	Anticipated Invoices To-Go
Construction						
Early Utility Relocation Contracts	0	0	0	0	0	0
Bridge Reconstruction Contracts	0	0	0	0	0	0
Bridge Repair Contracts	0	0	0	0	0	0
Future Contracts - Not yet defined/scoped	0	0	0	0	0	0
	0	0	0	0	0	0
Force Accounts						
Construction	0	0	0	0	0	0
Design	0	0	0	0	0	0
	0	0	0	0	0	0
Design Contracts & R.O.W.						
Right-of-Way Agreements	0	0	0	0	0	0
DCR Design Consultants	0	0	0	0	0	0
MHD Consultants	0	0	0	0	0	0
Future Design Contracts -Not yet defined/scop	0	0	0	0	0	0
	0	0	0	0	0	0
Management						
MHD Management (Design)	0	0	0	0	0	0
MHD Management (Construction)	0	0	0	0	0	0
DCR Management (Design)	0	0	0	0	0	0
DCR Management (Construction)	0	0	0	0	0	0
Consultants	0	0	0	0	0	0
Mitigation	0	0	0	0	0	0
Auditors	0	0	0	0	0	0
Other	0	0	0	0	0	0
	0	0	0	0	0	0
Insurance Expenses	0	0	0	0	0	0
Contingency & Finance Cost						
Contract Contingency (Allocated)	0	0	0	0	0	0
Contract Contingency (Un-allocated)	0	0	0	0	0	0
MHD/DCR Contingency	0	0	0	0	0	0
EOT Contingency	0	0	0	0	0	0
Finance costs	0	0	0	0	0	0
	0	0	0	0	0	0
Program Exposures						
Construction Contingency (>15% growth)						
Designer Contract Cost Growth						
TOTAL ACCELERATED BRIDGE PROGRAM	0	0	0	0	0	0
Other Betterments*	0	0	0	0	0	0
* Not included in Total Project Cost or Construction Cost Total						

1.A.8 – Monthly Status Reports

For a program the size and complexity of the Accelerated Bridge Program, a vast amount of data will be generated. The reporting of this data is vital not only to the program management team but also to the various stakeholders in the Program. The Agencies will prepare and distribute monthly status reports that will detail information to all levels of project involvement.

Through the use of the existing Agency software, the ABP will create detailed monthly reports. Separate reports will be prepared for:

- the individual project level

- the district level
- the Executive ABP level

1.B PROGRAM COST CONTROL

1.B.0 – Summary

Chapter 233 of the Acts of 2008 requires that the Agencies track the Program's on-time and on-budget performance for the first three years against a 90% performance goal. Although both Agencies already implement many of the following measures in their current programs, the measures vary somewhat between the Agencies in both name and content. Therefore, to promote transparency for the ABP Program as a whole and to provide each agency with the benefit of the best practices available, the Agencies intend to formally adopt the following Program Cost Control measures. This will involve the adoption of new control measures as well as the upgrade of current practices

1. Performance Tracking Indicators and Program Schedule Control
2. Formalized Cost Containment Program
3. Peer Reviews
4. Program Management Oversight Advisor
5. Early Risk Task Force
6. Program Overhead Control
7. Internal Control Meetings and Reporting
8. Value Engineering Studies (contracts greater than \$20 million)
9. Forecasting Risk and Exposures
10. Designer Accountability
11. Escalation
12. Major Commodity (Material) Pricing Fluctuations

Each of these measures is discussed in greater detail below.

1.B.1 – Program Schedule Control and Performance Tracking Indicators

One of the most significant factors in controlling cost of a large program such as the ABP is maintaining Program and project schedules. Therefore, an ABP Integrated Program Schedule will be developed and maintained to provide Agencies the ability to review and report on the overall health of the Program and standardize the management of multiple projects. This will be accomplished by requiring all ABP project schedules to conform to a structure that is consistent in content and organization. This will allow reporting on the status of the individual projects, as well as summary level reporting, for various breakdowns such as by city/district/region, fiscal year budget planning, or critical letting and construction milestones.

This program will also be developed with a procedure that promotes accountability at the contract level and transparency/visibility at the Program Management level.

The objective of this Program Cost Control Measure will be to:

1. Ensure transparency in reporting project/contract level problems;
2. Provide a system of accountability at the project/contract level;
3. Ensure that program level decisions are based on all critical contract level considerations;
4. Develop an efficient mechanism to summarize and report on the overall ABP program health; and
5. Provide the ability to create multiple levels of reporting for ABP projects within the larger program. The implementation of a consistent schedule structure will allow standardized routine reporting within the overall Program, at the most detailed level.

Control/Accountability Aspects

The Agencies' Integrated Program Schedule will be generated with a formal procedure to ensure accountability at the project level. This will be done through the following steps:

1. The construction contractor will provide weekly construction updates during the weekly construction status meeting held by the Agencies' Resident Engineer/PM. The Agencies' Scheduler will be in attendance and receive meeting minutes.
2. The contractor will provide monthly construction schedule updates in accordance with the requirements of the Agencies' scheduling specification.

3. Upon receiving the Contractor's schedule, the Resident Engineers (and/or District Schedulers) will review the schedule and provide comments in a written report to the ABP District Construction Engineer in a timely manner.
4. The District Construction Engineer will promptly review the report and provide direction to the District Scheduler on how to proceed with the monthly update of the Integrated Program Schedule.
5. The District Scheduler will routinely update the Integrated Program Schedule that will be utilized for summary level reporting. The Program Controls Group will be responsible to coordinate the information from the field, ensure consistency in reporting and prepare the reporting information.

The following steps will be taken by Agencies to provide for successful program level schedule implementation:

1. Develop the desired program-level reporting for time, cost and resource status;
2. Determine the appropriate schedule structure and schedule loading requirements based on the Agencies' needs for the current Program;
3. Refine the schedule specifications to be included in contract documents for each Agency's project within the Program; and
4. Create desired Program-level reports concurrently with the review of the individual project schedule updates on a monthly basis.

Organization Requirements

The key to the Integrated Program Schedule is the creation and implementation of a specified work breakdown structure (WBS) that will become the basic organizational structure for each project schedule. Program level schedule report formats will also be developed. Each construction contract will include similar WBS and schedule loading requirements at bid letting. Once the WBS has been implemented throughout the program, program status reports will be developed on a monthly basis coinciding with the monthly updates provided for each project. The program-level reporting can be provided concurrently with or independently of the individual integrated project schedule update.

Performance Tracking Indicators

See Section I.A.2 above for a discussion of this Measure.

1.B.2 – Formalized Cost Containment Program

The Agencies will initiate a formal Cost Containment Initiatives Program. This program will be implemented by mid-2009 and will survive for the life of the ABP duration (8 years).

The main goal of this program will be to:

1. Standardize cost savings for multiple projects, construction methods, material efficiencies.
2. Formalize the cost containment program to ensure initiatives have been adequately evaluated.

In order to perform this program, the following steps will be implemented:

1. Create an active/formal Program Management endorsement of the fundamental principle for Program Management, employees, and consultants to be actively/continuously pursuing cost containment ideas.
2. Create a formal cost containment review panel to evaluate cost savings, schedule savings (design, procurement, and construction), and/or claims avoidance. The review panel will have one senior cost analyst, designer, construction manager, and a claims analyst.
3. The panel will log all ideas, evaluate, and report to Program Management on a bi-monthly basis.

1.B.3 – Peer Reviews

The Agencies will budget for and utilize a formalized Peer Review Program. This program will be utilized for all contracts >\$50 Million and on a case-by-case basis for other contracts (<\$50 Million).

The main objectives of this Peer Review Program will be to:

1. Evaluate other potential options that may be cost-effective or may improve the completion of a bridge contract.
2. Supplement the Agencies' management staff to provide additional technical support and resources.
3. Provide an additional level of review on critical projects beyond the existing Program management.

The peer review will be conducted periodically to provide a detailed forensic analysis, claim review, and other audit type exercises. The Peer Review team will evaluate a variety of project elements including cost reports, construction documents, schedules and other items.

Specific Scope of Services

1. Perform an independent review of the current project scope, budget and schedule vs. compliance with the originally planned scope, budget and schedule.
2. Evaluate the existing contractual obligations and the extent to which Contractor and the Agencies have met those obligations.
3. Identify any gaps in responsibilities between the project team members and/or any disconnects between the Agency's expectations and each team members' contracted scope.
4. Evaluate the current budget and the general budget trend/exposure for the completion of the project.
5. Perform an exposure assessment of current major open issues (values exceeding \$250,000) and recommend potential courses of action.
6. Identify systematic or organizational issues and opportunities to improve performance.
7. Evaluate current Schedule Construction Controls Program and make recommendations for potential revisions as warranted, including indentifying any specific deficiencies or concerns.
8. Identify apparent major schedule risks – identify specifics in the schedule and provide recommendations for mitigation. This will include a brief review of items that are viewed as aggressively planned.
9. Evaluate remaining top critical paths and provide an adequate measuring tool for the Contractor's accountability and evaluation of feasibility of the remaining schedule.
10. Briefly evaluate sub-critical paths and provide any observations or recommendations to evaluate further.
11. Briefly evaluate any potential schedule recovery steps that should be evaluated further by the Contractor.
12. Summarize with a narrative/plan for: making corrective action to, help avoid additional schedule delays, highlight any positive aspects/outlooks, and provide

any specific recovery plans (if possible). This will include a detailed schedule report.

Review selected documents

- Agency Designer Contracts
- Agency Contractor Contracts
- Base-Bid Construction Documents (Plans and Specs)
- Current version of Plans and Specs
- Contract Budget (Original and Current)
- All significant change orders
- Project Schedules (baseline and all applicable updates)
- All Schedule extensions and revisions to the baseline schedule
- Current and past payment requisitions
- All major pending Claims/Disputed issues (Over \$250,000)
- Quantity takeoffs and estimates generated by others

A similar Peer Review Team will be implemented for selected Design Cost reviews, Construction Cost Reviews (during design), and Program Management Cost Reviews.

1.B.4– Supplemental Program Management Oversight Advisor (PMOA)

The Agencies will budget for and utilize a supplemental Project Management Oversight Advisor for selective critical aspects of the Program, primarily to assist in an independent audit fashion. This advisor may be utilized to provide an independent evaluation of problematic contracts (design or construction). The PMOA will be selected by the Agencies based upon qualifications and a presentation of applicable knowledge related to Program Management of this magnitude. This PMOA will be specifically selected for Program Controls, including proven knowledge in:

- Construction Cost Estimating
- Construction Scheduling
- Budgeting
- Reporting
- Document Control
- Project Management
- Inspection
- Quality Control
- Claims Analysis
- Trending and Forecasting

The main objective of this PMOA will be to:

1. Supplement the Program management staff in providing additional technical support and resources.
2. Provide an additional level of review beyond Program management.
3. Assist in training district staff project managers.
4. Assist in preparation of reporting and budgeting demands.

1.B.5 – Early Risk Task Force

The Agencies will form an Early Cost Risk Task Force that will develop critical cost and schedule related information related to these common areas of concern:

- Right-of-way (timing and cost)
- Permitting impacts
- Utility and structure ‘as-builts’
- Geotechnical information
- Environmental review
- Construction contingency validation

The development of this information will:

- Ensure consistency
- Identify best approaches when dealing with outside influences
- Enable scope and cost definition of conditions to be handled at a program level
- Identify and manage project risks that may have broad design and budget implications

Early Risk Task Forces will be comprised of a representative of each of the relevant major disciplines (land acquisition, permitting, utility, legal, construction, design), a cost estimator(s) and a construction scheduler. This group will routinely review and present to Program Management the potential cost and schedule impacts to the project posed by the types of early project risks delineated above, as well as the potential impacts to early design priorities and milestones. This group will also be responsible to prepare and present possible mitigation measures. Depending on the need and personnel assigned, multiple Task Forces may be established.

1.B.6 – Program Overhead Control

Currently, a preliminary budget of approximately \$390 million has been allocated for non-construction/program overhead costs. As part of the mandate to maintain transparency, in the future months, the Agencies will provide a clear budget allocation of the program ‘overhead’ costs. These costs include Agency salaries, equipment, rent, financing, debt, insurance, utilities, furniture, vehicles, Program (non-design) consultants, materials, supplies, and maintenance. All of these costs will have an escalation

projection performed as well. Over the next several months, Program Management will evaluate these costs in much more specific detail, and will do so in a manner that uses past historical data to generate a defensible budget of these overhead costs.

The objective of Program Overhead Control will be to:

1. Perform a systematic budget evaluation of the cost to ‘overhead’ ratio.
2. Assist in the allocation of the overall program contingency. As indirect (i.e. ‘overhead’) and direct (i.e. contract specific) centers are formalized, the remaining overall ABP appropriation becomes contingency (allocated and unallocated).
3. Ensure transparency in reporting the development of Program-related cost projections, followed by the regular status update of actual expenditures.
4. Allow ample time to properly scope and budget for the entire Bridge Program duration before budget tracking is fully committed.
5. Ensure that program level decisions are made with all contract level considerations as its basis. This would include using past history to evaluate the ratio of non-manual workforce (inspectors, resident engineers, designers, office engineers, etc.) it takes to efficiently manage bridge projects by cost range.
6. Develop an efficient manner to summarize and report on the overall Program health.

The following steps will be implemented:

1. **Field Management Ratio** – First, an evaluation of past historical data will be performed by an internal task force of Agency personnel. This historical evaluation will include a selection of some of the better performing (cost and schedule) past bridge projects, to determine an optimal field management staff ratio (people/\$ of bridge contract – by major cost category). A projection of total field management staffing will then be done using the overall 8 year program schedule, and will utilize individual conceptual contract schedules as a guide. The Program is committed to manage to the \$390M that has been allocated for ABP indirect program costs.
2. **Other ‘Overhead’ Costs** - A separate evaluation will be done by a second Agency task force. This group will evaluate budget of non-construction costs to successfully manage a program of this size. This group will also evaluate finance, insurance, salaries, equipment, rent, payroll, accounting, financing, debt, insurance, utilities, furniture, vehicles, consultants, materials, supplies, and

maintenance. This evaluation will consider past overhead budgets (comparing the ratio of \$ to design and construction / on an annual basis), and will consider the Field Management Ratio above.

3. This Program Budget function (i.e. indirect costs) will also be revisited and adjusted regularly as part of the overall Program Budget evaluation.

1.B.7 – Internal Program Control Meetings

The Agencies will hold regular internal Senior Project Management control meetings. These meetings will be implemented immediately and extend through the end of the ABP duration (8 years).

The main objective of these meetings will be to:

1. Create and maintain the accountability and transparency required for the legislative reporting requirements.
2. Generate a formalized senior management review process that allows for program level priorities to be evaluated and acted on as efficiently as possible.
3. Identify specific schedule and cost control priorities to be addressed in further detail in the Critical Actions Meetings (see section 2.C).
4. Identify action items to recover costs (and/or delays).

1.B.8 – Value Engineering Studies

In 1995, Congress passed the National Highway System (NHS) Designation Act which included a provision requiring the establishment of a program that would require States to carry out a VE analysis for all Federal-aid highway funded projects on the NHS with an estimated total cost of \$25 million or more. On February 14, 1997, the FHWA published its VE regulation in 23 CFR 627 establishing such a program and concurrently reduced the dollar threshold to \$20 million. The successful administration of the VE program can contribute measurable benefits to the quality of the surface transportation improvement projects and to the effective delivery of the overall Accelerated Bridge Program. The following table summarizes recent benefits realized nationwide by the FHWA when conducting VE.

Summary Of Past VE Savings Federal-Aid Highway Program					
	FY 2007	FY 2006	FY 2005	FY 2004	FY 2003
Number of VE Studies	316	251	300	324	309
Cost of VE Studies Plus Administrative Costs	\$12.54 Mil	\$8.15 Mil.	\$9.80 Mil.	\$7.67 Mil.	\$8.42 Mil
Estimated Construction Cost of Projects Studied	\$24.81 Bil	\$21.53 Bil.	\$31.58 Bil.	\$18.7 Bil.	\$20.48 Bil.
Total No. of Recommendations	2861	1924	2427	1794	1909
Total Value of Recommendations	\$4.60 Bil	\$3.06 Bil.	\$6.76 Bil.	\$3.04 Bil.	\$1.97 Bil.
No. of Approved Recommendations	1233	996	1077	793	794
Value of Approved Recommendations	\$1.97 Bil.	\$1.785 Bil.	\$3.187 Bil.	\$1.115 Bil.	\$1.110 Bil.
Return on Investment	157:1	219:1	325:1	145:1	132:1

Resource - <http://www.fhwa.dot.gov/VE/>

In the Accelerated Bridge Program, the Agencies will continue the current policy of Value Engineering.

1.B.9 – Forecasting Risk & Exposures

The Agencies will periodically account for forecasting the exposures of each construction contract. This will be performed on a quarterly basis, to support the reporting requirements included in Section 12 of the ABP Legislation. This component of the Program will be implemented by early 2009, for all construction contracts that are currently active, and will survive for the life of the ABP duration (8 years).

The objective of this program will be as follows:

Develop a comprehensive cost that identifies current scope, cost-to-date, and allowances for all future potential costs, known or unknown.

The following steps will be implemented:

1. Assess all contractor claims and change orders and include an estimated cost where the Program has potential cost exposures.
2. Perform a future risk assessment to include an estimate for unknown future contractor claims or change orders. Various methods exist to estimate future risk.

The preferable method is to categorize remaining work into common scopes (i.e., utilities, excavation, etc.) and assess potential cost changes. The intent of this portion of the forecast is to establish a budget contingency for future costs that will not result in an unexpected contract cost at completion.

3. Review all unit-priced pay item quantities (if any exist within the contract) and forecast quantities at contract completion.
4. Identify all traffic control costs incurred to date, if any, and include a forecast for to-go traffic control costs.
5. Obtain input from the designer(s) regarding future design changes being contemplated by the designer and include estimated costs for potential scope changes.
6. Include an overall comparison to the previous forecast(s) and identify significant variances from the previous forecast.

An ABP Program Budget exposure has been identified to monitor a construction contracts progress, Program Management will consider performing a study of the past bridge project completion costs and timeframes. If the findings conclude that there needs to be a budget allotment of much greater than the 15% previously added, then Program Management will adjust the program and Budget Control in a reasonable manner. This will also become part of the Program Performance Indicators.

1.B.10 – Designer/Engineer Accountability Program

To foster a team approach from the Designers and Contractors, the Agencies will implement a D/E Accountability program in the second quarter of 2009.

Because the ABP is in the conceptual stages, any true performance indicators provided this year (2008) will be premature and not based upon advanced designs. For many projects in the Program, at this stage insufficient scope definition, quantitative information (plan to provide pricing), or detailed/adequate costs assessments of other significant cost related impacts has been developed.

Therefore, Program Management will implement, for contract specific cost control during the design stage, a D/E Accountability Program that will maintain a high level of accountability for elements within the D/E's control while promoting a 'team' approach – see section 2.A.

The following steps will be implemented as the core of the D/E Accountability Program:

1. Select Designer/Engineer (or Design/Build) based upon qualifications.
2. The Designer will be required to work with an independent estimator(s). This Estimator will be required to work with the design team from the early stages of the design – to develop quantity and qualitative assumptions, assist with value assessments, develop contract payment items, price the estimates using accepted practices, and to work with the Agencies.
3. The Designer will be responsible for implementing the Construction Cost Estimating Protocol outlined in Section 1.C below. At the 75% stage, the Designer will be responsible for producing a “bottoms-up” construction cost estimate that will become the basis for measuring a project’s on-budget performance.
4. The Program’s Estimating Group will review this estimate and the reconciliation. They will evaluate the categorization of change (i.e. pricing changes, scope changes, design development, corrective action), and will file a determination of accountability report to ABP Executive Management.
5. During the design selection process, a strong part of the evaluation of a Designer’s past performance will be how the Designer responds to and plans for this Designer/Engineer Accountability Program. The discussion of qualifications, resources, experience with this more rigorous control, and the Designer’s justification of any form of contingency, will be considered.

1.B.11 - Escalation Costs

In order to maintain cost control and foster public trust in the Program’s budget, the Agencies will provide a clear budget allocation of escalation/inflation (“time value of money”) costs and contingencies at both a contract and a program level. Additionally, the Agencies will formalize a position on just how much, as a percentage of projected cost increase, will be allocated for the factors of escalation. The section below is specific to the cost escalation, recognized as a highly vital component of proper budgeting/cost control and a component of the performance of the Designers, the Contractors, and the ABP management staff.

It is important to note that the proposed definition of “on-time-on-budget,” for the purposes of the legislative reporting, **includes** a reasonable amount of escalation and contingencies in each construction contract as it evolves and in the overall Program Budget (*see Section 1.A.2, Performance Tracking*).

This section defines the recommended use of **contract specific escalation** during the evolution of the design phase of a typical ABP contract. In contract specific instances, escalation factors need to be calculated to include inflation factors for, at a minimum, construction costs, right-of-way acquisitions, labor costs, and general price inflation. The construction schedule should be utilized to help determine the budget. The section also discusses the cost of escalation of the **overall Program costs** for ‘non-construction’ type costs.

In light of the many recent financial market fluctuations, and because of the magnitude of the cost implications to the ABP, the Agencies will **initiate a third party study** by a professional local economist to evaluate the current percent cost growth to be expected, with specific regard to the Commonwealth and to bridge construction commodities, including labor. Once this study is complete and every year thereafter, an annual evaluation will be performed and appropriate budget adjustments using program contingency will be made. This will help to maintain transparency, establish a standardized approach to be managed by the ABP Cost Control Manager, and separate this volatile aspect from the accountability of the Designer/Engineer during the design phase.

Many current economic publications address the cost escalation factor of construction. It is rare for two publications to agree on what the percentage of escalation should be for future work. Moreover, each region of the country has varying cost increases. For example, a 5/13/08 article posted on the ABP website states “A recent report of the Federal Highway Administration estimated that road and bridge construction costs increase between 9 percent and 15 percent each year.” The FHWA statement is consistent with an unverified publication that has looked at the past five years and noted that the cost of highway and street materials has increased by 70%.



Prepared by ARTBA: The Leading Source of U.S. Transportation Construction Market Research

Increase In May Highway & Street Material Prices

The cost of highway and street construction materials was up 15 percent in May 2008 compared to the same month last year. During the same time period, inflation, as measured by the consumer price index, was 4.2 percent. Over the last five years, between 2003 and 2008, the price of highway and street construction materials has risen 70 percent. The italicized materials are some of the key components of the Highway & Street Construction Producer Price Index.

Highway & Bridge Construction Input Prices - Price Change From Same Month in Preceding Year						
	May 07 to May 08	Apr 07 to Apr 08	Mar 07 to Mar 08	May 06 to May 07	May 05 to May 06	May 04 to May 05
Highway & Street Construction	15.0%	12.2%	12.8%	5.2%	15.7%	9.8%
Asphalt Paving & Block Mfg	8.4%	5.2%	4.1%	10.8%	25.4%	7.1%
Cement	0.8%	-0.2%	3.2%	5.9%	14.7%	11.9%
Concrete Block & Brick	2.0%	1.9%	2.3%	4.8%	8.1%	8.7%
Construction Sand, Gravel & Crushed Stone	6.7%	6.5%	7.9%	9.0%	9.0%	6.6%
Iron & Steel Scrap	93.3%	57.3%	16.0%	12.2%	31.7%	6.0%
Ready Mix Concrete	2.4%	1.6%	1.2%	4.7%	12.9%	12.5%

Contract Specific Escalation Costs

This portion of the cost control plan will be implemented in the following manner and at the applicable estimate stages of design and construction.

1. As mentioned above, a third party study will be performed to develop a professional opinion of how much annual cost growth should be applied to the contract-specific budgeting.
2. To ensure consistency and proper forecasting practices, during each stage of the design, the professional cost estimator will use the Program-directed percentage of escalation. Based on the estimate generated at current year dollars, the estimator will then use the construction schedule to escalate to the mid-point of construction (more advanced approaches - based on year-of-expenditure, will also be acceptable).
3. This escalation amount will regularly be provided to the Program Cost Control Manager to report and budget for the escalation at the Program level and as part of the Performance Tracking Indicators. Again, this will be done at the various stages of design.
4. As the Engineer's Estimate is developed, and as part of an Program Executive Estimate Briefing for each major contract over \$5M, the estimating team will present the escalation calculation, showing how much of the predicted costs are included in the bid value.
5. Program budget entry will be provided for each contract account for the potential increase that the Agencies must budget.

Program Specific Escalation Costs

This portion of the cost control plan addresses how escalation of “non construction costs” will be accounted in the Program Budget. During the early stages of the Program, very preliminarily budgets have been established for Program management. Those costs include Program salaries, equipment, rent, financing, debt, insurance, utilities, furniture, vehicles, consultants, materials, supplies, and maintenance. All of these costs need to have an escalation projection performed as well. Similar to the contract specific escalation, the Program will retain a third party to perform this study as well. This program budget function will also be revisited and adjusted annually as part of the overall Program Budget evaluation.

1.B.12 – Monitoring Major Commodity (Material) Pricing Fluctuations

Unprecedented high escalation on selected construction materials and fuel driven by international demand is causing substantial impacts to highway bridge projects. Allocations to properly budget for these costs must be carried in the project budget from the conceptual stage through construction. To account for this on the Program level, two significant cost allocations were performed prior to submitting the Accelerated Bridge Plan.

1. A 9% annual Escalation Rate was added to all cost estimates – and done so in a manner that attempts to forecast the future bid values by escalating to the mid-point of construction.
2. A 15% Construction Contingency was also included in the recent estimates. This is to account for an aggressive (i.e. well managed) cost growth factor that is anticipated after the Contractor has been awarded a contract.

The ABP Program Budget will monitor the impacts of material pricing.

Anticipated commodities for escalation clauses based on historic increases and current volatility include:

- Steel
- Cement
- Hot mix asphalt
- Fuel (as it relates to operating construction equipment or providing temporary heat)
- Fuel (as it relates to material delivery surcharges)

1.C PROJECT-BY-PROJECT COST CONTROL MEASURES

1.C.0 – Construction Estimating and Contract-Specific Contingencies– Summary

Construction Cost Estimating

Generating reliable and accurate cost estimates throughout the entire cycle of the Accelerated Bridge Program (design phase, bid, construction, and change order management) is vital to the ABP Cost Control Program. All construction cost estimates for ABP projects must be developed in a consistent, systematic, structured manner. The “**bottoms-up**” approach to cost estimating will be used for developing the Lump Sum Bridge (LS) construction cost estimates on all future (beyond Dec-08) Accelerated Bridge Program projects as they progress into the 75% design phase.

Quality Control/Quality Assurance Plan - Estimating

A cost estimating Quality Control/Quality Assurance procedure has been developed for the Accelerated Bridge Program. In order to enhance the validity of project cost estimates, most cost estimates prepared for the ABP will receive a quality control (QC) review in accordance with the procedure.

Contract-Specific Contingencies

Section 1.C.4 defines the use of contract-specific cost contingencies during the evolution of the design phase of a typical project in the Accelerated Bridge Program. It is important to note that the proposed definition of “on-time-on-budget” for the purpose of the legislative reporting includes a reasonable amount of cost and schedule contingency. This is a vital component of proper budgeting and cost control that must be a component of the performance of the Designers, the Contractors, and the ABP management staff.

1.C.1 – Construction Estimating Program

The ‘bottoms up’ cost estimating approach is more effective because estimates are developed based on the way that the project will be constructed rather than merely applying unit prices to quantity take-offs. Bottoms-up estimating involves developing costs for the crews, equipment, and production rates that a contractor would use in constructing the project, and developing the estimate based on this information. A ‘bottoms-up’ cost estimate reflects a buildable approach to the work, while at the same time building in a constructability check. Moreover, crew, equipment, and production rate information can be easily translated into a project construction schedule that is integrated with the cost estimate. This early linking of project cost and project schedule fosters effective cost and schedule control throughout the life of the project.

For bottoms-up estimates, prices at the detail level for material, equipment, and labor must reflect local/industry pricing to the maximum extent possible. Time and care must also be taken to develop contingencies, overhead costs, general conditions costs, and profit rates in a sound, logical manner, rather than by applying blanket percentages.

For all common elements (other than the Lump Sum Bridge item), MassHighway has recently implemented a “Weighted Average” unit price tracking program. This system has allowed MassHighway to estimate unit priced items (usually amounting to < 20% of the contract value) more easily. Because of the consistency noted by MassHighway over the past year, and to assist in keeping consultant costs lower, the Weighted Average program will be continued during the early design phases. Designers (and the independent estimators) will be required to perform a validation of these unit prices as part the final Engineer’s Estimate (75%).

Lump Sum Bridge items (and any other significant lump sum item) will nevertheless be required to be derived from the “bottoms-up” approach, from an independent cost estimator, beyond the 25% design stage (part of the 75%, 100%, and PS&E submissions).

Early Conceptual Estimating (prior to 25% design)

Bottoms-up estimates cannot be developed at the early conceptual stages of a project since there is not enough scoping information available to allow for detailed development of crews, equipment, and production rates. Accordingly, it is necessary for ABP project designers to use high level parametric estimating (pricing by square foot, cubic yard, tons of steel, etc.) coupled with the application of logical assumptions to develop early conceptual estimates. Parametric costs that are used will be based on local historic costs from projects with similar scope, coupled with any known current market cost trends. The level of detail of the assumptions used will vary from project to project, but the estimator shall discuss and validate all assumptions with the project design and construction representatives. These early estimates should include high contingency costs to account for: the lack of scoping detail; changes to the scope that will inevitably occur as design progresses; known and unknown project risk factors; and market fluctuations that will occur over the life of the project. As the design progresses and more detail is added to the design documents, contingencies will be decreased.

As part of the 75% design submission, all construction cost estimates will begin with a detailed quantity take-off. The independent estimator will then develop a logical work breakdown structure for the project, followed by the crews, equipment, and production rates that will be used in constructing each element of the work. Once this information is developed, the estimator will then develop pricing information (again using weighted averages for normal unit prices and the “bottoms-up” approach for lump sum and/non-routine elements).

Labor pricing shall be current and shall incorporate:

- Appropriate Prevailing Wage rates and fixed fringes for the local area;
- Variable fringe/burden calculations based on assumption of hours per working year or years of retention (e.g. holidays and vacation for some Union trades);
- Workers compensation rates;
- Appropriate payroll taxes and insurances (Federal and State Income tax; Social Security; Medicare; Mass. Health; etc); and
- Assumed contractor healthcare and vacation benefits.

Pricing of overtime and shift work shall reflect appropriate local (union) labor wage premiums and appropriate calculation of payroll taxes and burdens above. This will be evaluated as part of the 100% submission, following the completion of a detailed Contract Time Determination study (i.e. detailed construction schedule) that utilizes information from the 100% construction cost estimate.

All estimates will contain an appropriate level of contingency to account for: stage of design; level of scope definition; difficulty level of construction; chance of scope creep

during design; chance of scope creep during construction; construction risk factors (subsurface conditions, hidden conditions, hazardous materials, form of construction contract, construction contract pay item structure, market price trends); bid climate; etc. The estimate contingency should be applied below the bottom line of the cost estimate and not included in quantities or unit pricing.

All estimates will contain appropriate **markups for indirect costs** including home office overhead, profit and insurance (special coverage such as pollution, marine, and other unique job requirements) and bonds.

All estimates will include **escalation** to the midpoint of construction, calculated monthly or yearly. Useful indices to determine the applicable escalation rate may include Engineering News Record, Consumer Price Index for materials, Metals Weekly, various D.O.T. and FTA escalation materials indices, and local sources. However, because of its size, the Accelerated Bridge Program will develop a standard escalation factor, to be used by all estimators, that is generated by a professional economist.

1. All site-specific Construction Cost estimates (greater than \$1M) will include an Executive Summary of costs by the ABP Work Breakdown Structure.
2. All estimates will be developed into appropriate summary level Unit Costs at total and Systems cost levels, to allow for cost benchmarking, (e.g. cost per Bridge Foot, cost per Lane Foot, cost per LF of vertical foundation; cost per CY of concrete or earth; etc).
3. Each estimate at the 75% submission for all site specific construction contracts greater than \$1 Million shall be accompanied by a Basis of Estimate narrative. The Basis of Estimate shall may include the following:
 - List the specific project documents and source documents forming the basis of estimated scopes and assumptions. Identify sources and dates.
 - Identify all scopes, quantities, and costs, provided by sources other than the estimating team (e.g. 'pass-through' Allowances provided by the Agencies, Designer, or end-user.)
 - Reconcile major scope changes from prior estimates, *as identified by the design team*.
 - Reconcile summary level cost variances from prior estimate, in tabular or narrative form.
 - Reference, and explain, detailed estimate 'backup' such that third party readers can correlate summary level information with the backup.
 - Outline unresolved scope or cost issues.
 - Describe estimate departures from project documents, and why they are included (e.g. constructability).
 - Describe estimate assumptions regarding site access restraints.
 - Describe estimate assumptions regarding sequence of work and labor shifts.

- Describe the specific estimating methodologies employed- e.g. parametric; detailed; quoted; historical, or other sources.
- Describe the basis of material cost development, labor cost development, equipment cost development, markups development.
- Describe the basis and levels of project markups- level of overhead, profit, and soft costs applied, with justification.
- Describe contingencies applied and how they were developed.
- Describe escalation markup applied to bottom line, calculated to the midpoint of construction, utilizing project dates identified by the team.
- Outline major project risks that may significantly impact project costs.
- Where formal, or informal, Risk Analysis has been employed, outline how it has been used in development of the cost estimate.

The Importance of the Estimator

The professional estimating team is the ABP Program's principal line of defense in ensuring project design is likely to meet construction budget expectations. Whereas each design professional in the team may work on a subset of the project scope, the estimators must become familiar with all content in all documents, and will frequently identify issues that may not otherwise be apparent to the design team. Developing estimates with the mindset of developing a bid estimate will allow the estimator to produce valuable feedback to the design and owner team regarding final document clarity, accuracy, bidability, and constructability. A professional independent estimator will be well versed in fulfilling these multiple roles.

1.C.2 – Quality Assurance Check - Estimating

In order to enhance the validity of project cost estimates, most ABP cost estimates will receive a quality assurance (QA) review in accordance with the QA Guidelines attached hereto. All QA reviews shall be performed by the ABP Program Controls Group. The reviews shall follow the steps contained herein, and shall be documented in writing in the cost estimate file.

QA Review Guidelines

Scope Review

Review the scope of the work for which the estimate was developed. Documents to be reviewed include scope descriptions, plans, specifications, studies, and correspondence. Check to see that all scope elements are included in the estimate.

Estimate Format

Review correspondence and other documentation provided by the estimator which identifies the required format that the estimate is to be presented in, e.g. CSI, bid item numbers, *Uniformat*, etc., and check to see that the estimate is in the required format.

Summary Level Pricing Check

Review the summary level pricing represented by the overall estimate, if feasible. For example, check the overall square foot price of the estimate and compare it with pricing of similar bridge projects using the most pertinent pricing source available, e.g., historic project pricing, or estimating manuals. After checking the summary level pricing represented by the overall estimate, check the summary level pricing for each category of work (CSI Category, or Work Breakdown Structure element) using similar pertinent pricing sources.

Quantity Take-Offs

Check line item quantities. Review the estimator's take-off files to ensure the accuracy of quantities derived by the estimator. At a minimum, check quantities of major scope items comprising the majority of the cost of the project. Ensure that quantity take-off documentation is included in the estimate file prepared by the estimator.

Material Pricing

Check pricing of materials. Ensure that backup documentation is included in the estimate file prepared by the estimator for all items of material. Backup documentation may include vendor quotes, historic pricing from other recent estimates, photocopies of pages from estimating manuals, copies of recent invoices, or other pertinent substantiation.

Equipment Pricing

Check pricing of equipment. Ensure that backup documentation is included in the estimate file prepared by the estimator for all equipment. Backup documentation may include vendor quotes, historic pricing from other recent estimates, photocopies of pages from estimating manuals, copies of recent invoices or lease agreements, or other pertinent substantiation.

Labor Pricing

Check pricing of labor. Ensure that backup documentation is included in the estimate file prepared by the estimator for all labor. Backup documentation should include prevailing wage agreements in the vicinity of the project and other pertinent information. If appropriate, check to see that the backup includes a workup of the elements comprising the fully burdened wage rate.

Overhead and Profit

Check to see that overhead and profit have been included in the estimate. Check to see that the overhead and profit rates used are appropriate for the project. Ensure that the estimate file prepared by the estimator contains a discussion/workup of overhead and profit rates used.

Contingency

Check to see that the estimate contains an appropriate level of contingency, taking into account the following factors: stage of design; level of scope definition; difficulty level of

construction; chance of scope creep during design; chance of scope creep during construction; construction risk factors (subsurface conditions, hidden conditions, form of construction contract, construction contract pay item structure, market price trends, etc.); bid climate; etc. Check to see that contingencies are applied in appropriate locations within the estimate (below the bottom line, spread through line items, etc.). Ensure that the estimate file prepared by the estimator contains a discussion/workup of contingency rates used.

Disposition of Review Comments

The QA Reviewer shall document all questionable cost elements identified during the review by red-lining the estimate, or other suitable means. The Reviewer shall then discuss the review, including all questionable cost elements, with the estimator. The estimator shall make adjustments to the estimate based on the comments provided by the Reviewer, and shall provide a copy of the adjusted estimate to the Reviewer. The Reviewer shall perform a final QA review of the estimate to ensure that all adjustments discussed with the estimator have been incorporated into the estimate.

1.C.3 - ABP Estimating Group

The Program will employ its own group of estimators within the Project Controls Group with program review and reporting responsibilities.

The ABP Estimating Group will be responsible to:

1. Review Cost Estimates (including quantity and pricing information) from Designers.
2. Report at a Program Level the status of cost.
3. Formally comment on differences in the cost estimates at different stages of design.
4. Generate Estimate Reconciliation sheets to show why the estimates have changed from one stage to the next.
5. Identify and monitor those aspects that the Designer is accountable for – alerting Program Management and design managers of discrepancies with recommendation to mitigate.
6. Review ‘method of measurement’ and ‘basis of payment’ provisions and payment items.
7. Develop and maintain a standardize construction cost estimating pricing, bid items, procedures.

8. Monitor bid results and participate in bid approval.

The intent of the ABP Estimating Group Measure is to:

1. Ensure a high degree of accountability for elements of work that the Designer/Engineer can control during the later stages of the design process.
2. Assist in promoting transparency and ‘reality’ of the true cost of construction.
3. Allow ample time to make corrective action during the design phase.
4. Promote a standardized approach to reviewing cost estimates at a Program level.

1.C.4 – Contract Specific Cost Contingency – from design to construction

The Agencies will apply a contract specific Cost Contingency during the evolution of the design phase of an ABP contract that follows the process outlined below. It is important to note that the proposed definition of “on-time-on-budget,” for the purposes of the legislative reporting, includes a reasonable amount of cost and schedule contingency; the section below is specific to the cost contingency.

1. Order Of Magnitude - Conceptual

In the earlier stages of the contract document preparation, when scope is not clearly defined and/or there is an apparently high degree of difficulty in the planned construction approach, a contingency will be allowed and budgeted for in the overall ABP Program Budget. This will be done on a contract specific case. Because the Agencies’ are currently using unit prices and conceptual estimates for many of the projects, it is proposed that a corresponding construction ***Cost contingency of 30%*** be included with any conceptual design estimates.

It is important to note however, that this 30% contingency is to be **added** to estimates of the ABP bridges that have not yet been fully estimated but have been scoped. For projects that have yet to be scoped (as of Dec-08), a contingency of 50% is recommended.

2. Preliminary (Budget) – Preliminary Design 25%

As a design actually starts to evolve, and as drawings allow for quantity development of major commodities, the professional estimator will work with the design team to develop an allowance basis of “immeasurable items” (example: assume #6 rebar at 6” on center). The schedule can be developed at this same degree of accuracy (15-30%). Therefore, the proposed construction Cost contingency will be lowered to ***no less than 20%***.

3. Definitive Estimate – 75% Design

In the later stages of design, as drawings progress to allow for much more accurate quantity takeoff and pricing, and as a construction scheduler can start to develop a crew-based approach to much more accurately define critical paths in the preliminary construction schedule, a “Detailed Control Budget” can be reasonably established. At this stage, the Cost contingency is proposed to be dropped **to no less than 15%**.

4. Detailed Engineer’s Estimate – Final Stages

In the later stages of design, as the Engineer’s Estimate evolves to allow for the full development of a detailed Engineer’s Estimate, it is proposed that the **Cost contingency be 10-15%** (depending upon study results below).

It important to note however, that it is **not** proposed that a 10% Cost contingency be included in the final Engineer’s Estimate (for advertisement). The Engineer’s Estimate is to be developed to provide for a reasonable cost projection of the contract documents provided (and not a prediction of the low bid). Cost contingencies to be added to the Engineer’s Estimate at this stage, will be discussed/evaluated, on a contract-by-contract basis, as part of the risk/exposure discussion of the Estimate Review Briefing with Senior ABP Management staff. The overall ABP Program Control Budget that will include a proposed 10-15% Cost Contingency (again, such contingency will not be part of the Engineer’s Estimate).

As mentioned in the schedule contingency section, and relevant to the cost component of this section, at the time of bid, the contract Time (i.e. contract duration) *will include 10% Time contingency* as part of the development of the Contract Milestones. This 10% Time contingency will include overhead, and escalation, as an allocated contingency in the overall ABP Program Control Budget.

5. Construction Phase

Once in construction, the same **10%-15% Cost contingency** will be utilized and budgeted for within the Program Control Budget to account for cost growth during construction.

Recommended contingency studies

ADDITIONAL STUDY – for construction contingency validation

An ABP Program Budget exposure has been identified to monitor a budgetary risk associated with the potential cost increases normally associated with highway/bridge construction in the Northeast (winter impacts and common delay issues).

To validate the 15% Construction Cost contingency implemented, after some construction contracts progress, the Agencies will perform a study of the past bridge project completion costs and timeframes. This study will be examine to the bridges that

have completed over the past 3 years and will compare the bid value vs. the actual Cost-at-Completion to determine a reasonable percentage for which to budget. This study may be commissioned within the coming months. If the findings conclude that there needs to be a budget allotment of much greater than the 15% previously added, then the Agencies will adjust the program and Budget Control in a reasonable manner.

1.D CONTRACT COST MANAGEMENT

1.D.0 – Contract Cost Management Summary

The ABP will adopt contract cost management measures that have proven to be effective in the industry. These measures include Constructability Reviews, Claims Avoidance Reviews, Contract Trending, and effective Contract Administration. When combined, all of these measures will allow Program Management to optimize management and control of costs at the project contract level.

1.D.1 - Constructability Reviews For Select Contracts

Constructability reviews will be performed on select site-specific ABP projects. Performing constructability reviews on construction contracts during the design phase is a proven method for optimizing construction contract costs and schedules and using the \$5 million threshold for projects receiving this review will achieve an appropriate cost/schedule benefit. An effective constructability review will identify project elements contained within the design documents that will hinder efficient construction and add unnecessary cost and time to the construction project. Requiring constructability reviews on all ABP projects will also ensure that specific construction knowledge and expertise are incorporated into the design of each project contract. It is important to perform constructability reviews early enough in the design process to allow for incorporation of pertinent comments and recommendations with minimum chance of requiring major re-design or design change.

1.D.2 - Claims Avoidance Reviews For Select Contracts

Claims avoidance reviews will be performed on select site-specific ABP projects. It is not possible to completely eliminate claims and change orders from the construction process; however, performing claims avoidance reviews during design is a highly effective means of minimizing claims and change orders during construction, and in turn minimizing construction contract costs and optimizing construction contract schedules. Effective claims avoidance reviews will identify specific areas within the project contract documents that are prone to construction change orders and claims, and provide specific recommendations on how to mitigate that exposure. The potential cost and schedule savings from an effective claims avoidance review will far outweigh the cost of performing the review.

I.D.3 - Effective Contract Administration

The ABP Program Management will maintain contract administration procedures on all ABP projects, with the objective of resolving and settling all construction change orders and claims as quickly and effectively as possible. The implementation of formal contract administration procedures, along with instituting an atmosphere of mutual cooperation between the Agencies and construction contractors will enhance the likelihood of successful projects, while minimizing the exposure to protracted disputes and their associated costs and schedule delays. Specific measures to ensure effective contract administration will include:

- providing adequate level of authority for ABP on-site representatives to negotiate and approve change orders;
- providing adequate contract administration resources/personnel for each ABP project;
- Maintaining clear/concise contract administration procedures and ensuring that construction contractors understand them;
- fostering an atmosphere of professional cooperation with construction contractors;
- reaching forward-priced change order agreements to the maximum extent possible;
- using unilateral contract modifications when necessary to keep construction work progressing; and
- use of auditors to verify high cost change orders and claims.

SECTION 2 – SCHEDULE CONTROL

2.A DESIGN PHASE SCHEDULE CONTROL

2.A.0 – Design Phase Schedule Control – Summary

The Agencies will require each ABP Designer to develop and maintain a detailed Critical Path Method (CPM) design schedule that will be used to monitor and track design progress; critical design tasks; critical decision dates; and critical actions required by all parties involved in the design process. These mandatory design schedules will ensure that the design phase of the overall ABP is progressing efficiently, foster more in-depth and transparent design planning, develop an auditable trail of accountability, assist in change management and budgeting, and support portions of the ABP legislative reporting requirements.

The key elements of effective design schedule control are: accurate schedules; reporting; transparency; accountability; and change order management. The following three documents will be used to support these key elements.

- 1.) Project Design Schedule – a detailed CPM schedule which shows how the designer plans to execute the design, planned resources (designer hours), design activities and their durations, and the logical relationship of each of the design activities.
- 2.) Design Consultant’s Monthly Report - a monthly summary report which includes the following information:
 - Overview
 - Accomplishments for the month
 - Upcoming key deliverables
 - Critical action items (listing person responsible and *need date*)
 - Summary financial report
 - Project Meetings – past and future
 - Community meetings
- 3.) Scope Statement – a descriptive statement of the project scope developed and managed by the Agencies’ Design Manager. The scope statement will be revised and updated as the design progresses. A reconciliation statement that clearly describes scope changes will also be developed at each stage of the design. The reconciliation statement will also include the specific reasons for all scope changes.

2.A.1 – Schedule Management and Performance During Design

The Agencies will require the ABP Design Consultants to provide in-depth and transparent design planning. Design planning will be centered around a requirement to provide a detailed baseline CPM Design Schedule which shows how the designer plans to execute the design, planned resources (designer hours), design activities and their durations, and the logical relationship of each of the design activities. These Design Schedules will be used to monitor and track design progress, critical design tasks, critical decision dates, and critical actions required by all parties involved in the design process.

This portion of the program control plan will consist of the following elements:

1. Design Performance Ratio

The Agencies will require Design Consultants to cost-load their Design Schedule, based upon planned resources, and provide a detailed breakdown of the Designer's overall fee. Performance of the Designers will be measured using a design performance ratio. Each month, in order to receive authorization for payment, the Designer will be required to submit a requisition that includes the following components:

- 1.) Planned incremental design fee – by discipline/task as related to the planned schedule (example Structural/design foundations = \$40,000 *planned* design fee expenditure up to the date of billing).
- 2.) Actual incremental design fee (example: Structural/design foundations = \$36,000 *actual* design fee expenditure up to the date of billing).
- 3.) The resulting performance ratio ($\$40k/\$36k = 1.11$)

This will allow the Agencies' Design managers to quickly identify areas of concern. Any task with a performance ratio above 1.0 indicates a possible delay in completing the design task.

This will be added to all future Design Requirements (after Jan-09).

2. Project Design Schedule

Design Consultants will be required to prepare and submit one (1) original and five (5) copies of a Design Schedule as part of their Project Management Plan submission to the Agencies for approval. This schedule will outline the activities to accomplish the design work, in accordance with the requirements of the Contract Time Provisions of the Design Consultant's Contract, and will be founded upon the existing Design Schedule Template.

- The Project Management Plan shall establish the framework for the project, including the organization of participants, responsibilities, decision structure, channels of communication and procedures to be followed in developing the design within the required timeframe.

- The Project Design Schedule shall establish all project milestones pertaining to data collection, field survey/inspection, preliminary and final design submissions, including plans, specifications and construction cost estimates, and construction phasing plans, if appropriate.

The Project Design Schedule shall be developed and maintained using MS Project or Primavera Scheduling software (or approved equivalent), and shall include such information as required in the standard bridge schedule template (as amended), or other schedule guidance issued by Agencies for the project. Design services shall be undertaken and completed in accordance with the Project Design Schedule as approved by the Agencies, and as revised and updated from time to time by Design Consultant. The Project Design Schedule shall be used by the Design Consultant and the Agencies for planning and monitoring the progress of the design work.

This will be added to all future Design Requirements (after Jan-09).

3. Project Tracking Points

The Project Design Schedule shall include interim design completion milestones, and shall clearly define the progression of the Work from NTP to design completion by using separate activities for all significant design components, including but not limited to:

1. Start project planning
2. Complete project planning
3. Environmental Impact Analysis
4. Right of way takings
5. Prepare design RFP
6. Advertise Design RFP
7. Award Design RFP
8. Start 25% design
9. Bridge sketch plans complete
10. 25% design public hearing
11. Complete 25% design
12. Bridge sketch plans approved
13. 25% design plans approved
14. Start 75% design
15. Bridge first structural submission
16. Complete 75% design
17. Bridge first structural submission approved
18. 75% design approved
19. Start 100% design
20. Bridge final structural submission
21. Complete 100% design
22. Bridge final structural submission approved
23. 100% design approved

24. Permit applications filed
25. Permits received
26. Issue Construction IFB
27. Open bids
28. PS&E Submission
29. Approval to Advertise
30. Advertise

This list is currently being finalized by the design schedule review team and is subject to change.

The Design Consultant shall update and submit the monthly Project Design Schedule. The monthly update shall: describe work completed during the reporting period; describe work planned for the next reporting period; explain and comment on schedule delays; provide costs-to-date and a statement of the adequacy of the remaining design budget; indicate MBE/WBE/DBE activities; and indicate anticipated problems with recommended solutions.

4. Design Consultant's Monthly Report

As part of the monthly requisition for payment, the Design Consultant shall also prepare a monthly summary report to include the following aspects:

- Overview
- Accomplishments for the month
- Key deliverables upcoming
- Critical action items (listing person responsible and *need date*)
- Summary financial report
- Project Meetings – past and future
- Community meetings

2.A.2 – Scope Statements

Industry experience has shown that infrastructure project scopes have an inherent tendency to change over time due to a variety of factors. These scope changes almost inevitably result in changes to project costs and schedules. Accordingly, it is **essential to record and monitor project scope** from project inception through final construction completion. Tracking and recording all changes to project scope enable accurate and effective management and reporting of associated cost and schedule growth. Early development and continuous updating of project scope statements is a tool that will enable Agencies to monitor and control the effects of scope changes on all ABP projects.

The Agencies' design managers will develop a scope statement for each ABP project at initial project inception. The scope statement will be revised and updated at each stage of the design. A reconciliation statement that clearly describes scope changes will also be developed at each stage of the design. The reconciliation statement will also include the specific reasons for all scope changes and all associated cost and schedule changes.

The function of this control measure will be to:

1. Assist in overall change management.
2. Assist in promoting transparency and ‘reality’ of the true cost of construction.
3. Allow ample time to take corrective action during the design phase.
4. Promote a standardized approach to developing the early scoping documents, and managing and controlling project scopes over time.

Contract specific Scope Statements

For each ABP project, the project Scope Statement will be updated at the following points in time:

1. Contract Specific Design Budget - before Designer selection
2. Contract Specific Design Budget - after Designer selection
3. 25% Design Stage
4. 75% Design Stage
5. 100% Design Stage
6. Engineer’s Estimate (PS&E)
7. Contract Completion (identifying all major changes)

Initial Implementation

A standard form will be developed (by Feb-09) to utilize on a future ABP projects. This form will be filed at each design phase and identify when each significant scope change is made. This will document the history of the scope changes over the life of the project.

2.B - CONTRACT TIME DETERMINATION

2.B.0 – Contract Time Determination – Summary

In order to minimize costly delays during construction, it is vital that a Critical Path Method (CPM) Schedule be developed during the planning stages of every ABP project. This CPM schedule needs to be founded upon the critical elements of the contract documents (including limitations of operations), the corresponding construction cost estimate data, and a reasonable determination of the possible construction means-and-methods.

During the design phase, the Agencies will ensure that professional construction schedulers are utilized to prepare construction schedules that will determine the overall Contract Time (duration) of each ABP construction contract. This will be referred to as the Contract Time Determination schedule (a.k.a. pre-bid construction schedule), and will be utilized throughout the design phases.

The Agencies will also ensure that the critical information (crews, equipment, production rates, quantities, construction sequence) from the construction cost estimate (section 1.C) is integrated with the basis of the Contract Time Determination schedule. This will also assure that contract documents have been planned with efficient construction planning practices.

Once the construction contract has been awarded, this Contract Time Determination schedule will be compared with the construction contractor's Baseline Schedule submission. This will ensure that the Contractor has incorporated all scope elements in its schedule, is not positioning for a schedule claim, is utilizing the schedule to logically plan the work, and has planned the work properly to avoid major surprises or delays.

This schedule also contains a quality control review plan for Contract Time Determination schedules that will be used on ABP projects.

2.B.1 – Contract Time Determination (Pre-Bid Schedule)

Critical Path Method (CPM)

The Contract Time Determination schedule and the construction schedules that are required from the Contractors will be developed using the CPM. This method is the industry standard and calculates the longest path of planned activities to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are "critical" (i.e., on the longest path) and which have "total float" (i.e., can be delayed without making the project longer). In project management, a critical path is the sequence of project network activities which add up to the longest overall duration. This determines the shortest time possible to complete the project. Any delay of an activity on the critical path directly impacts the planned project completion date (i.e. there is no Float on the critical path). A project can have several, parallel, near-critical paths. An additional parallel path through the network with the total durations shorter than the critical path is called a sub-critical or non-critical path. Float is the amount of time an activity can be delayed without impacting the milestone or project completion date.

It will be the responsibility of the Design Consultant on site specific construction contracts greater than \$1 Million (construction value) to utilize a qualified construction scheduler to develop the Contract Time Determination schedule. A schedule submission will be required following the submission of each construction cost estimate.

These types of schedules will not be submitted until after the construction cost estimate is complete, in order to provide adequate time for the professional scheduler to utilize the data generated in the construction cost estimate. In general, these schedule submissions will be due to the Agencies no sooner than 3 weeks and no later than 5 weeks, after the construction cost estimate has been completed.

This will be added to all future Design Requirements (after Jan-09).

The steps to implement this control measure are to:

1. Require an evaluation of critical resources, shift differential, overtime, and construction escalation costs as part of the Engineer's Estimate (PS&E) and Contract Time Determination schedule. This will also serve as a means of assuring that contract documents have been planned with efficient construction planning practices.
2. Compare the Contract Time Determination Schedule to the construction contractor's Baseline Schedule submission once the construction contract has been awarded. This will ensure that the Contractor has incorporated all scope elements in its schedule, is not positioning for a schedule claim, is utilizing the schedule to logically plan the work, and has planned the work properly to avoid major surprises/delays.

Use of Critical Data from the Construction Cost Estimate

The Agencies will ensure that the data (crews, equipment, production rates, quantities, construction sequence) from the detailed construction cost estimates is utilized in the development of the Contract Time Determination schedule. The professional scheduler will develop the logic (activity relationships) and activity durations, using the data from the estimate. Production rates and labor hours will be used to develop reasonable crew hours that are based upon a reasonable crew composition (*example: 1 labor foreman, 3 journeymen, and 1 apprentice*). This evaluation will also consider to the intended construction sequence.

Milestones and Access Restraints

Contract Milestones are contractual dates by which the Contractor will be obligated to complete work. The Agencies include a date for completion of the work as well as a Liquidated Damages clause in each construction contract to protect the Agencies from damages resulting from inexcusable late completion.

Access Restraints are also contractual dates. However, these are included in the contract to serve as a contractual means to control the start the contractor's work. (*Example: "the contractor will receive access to parcel 45 no sooner than 60 days from the Contract Notice-to-Proceed date."*)

The Designer's Professional Scheduler will be responsible to work with the Agencies to determine which Contract Milestones and Access Restraints should be included in the contract provisions and to include them in the Contract Time Determination schedule.

Limitations of Operations – Construction Constraints

Limitations of Operations are important restraints that the Contractor must be aware of in order to adequately develop a construction cost estimate (bid) and schedule. (*Example:*

“The Contractor will not be allowed to perform any work after 6:00PM”). In order to minimize construction claims, ensure quality bidding, and avoid major discrepancies with the Engineer’s Estimates, it is vital that these Limitations of Operations be clearly defined in the construction contract. The Designer’s Cost Estimator and scheduler will be required to communicate regarding the implications of these constraints.

Open Ends

A CPM schedule relies on the logically tied relationship of each activity. “Open Ends” are created when an activity does not have a successor (i.e. an activity that depends upon the completion of a predecessor activity). The professional construction scheduler will ensure that all of the activities in the overall schedule have been adequately tied and that there are no open ends in the schedule.

Other Important Elements

The professional scheduler will also be responsible to ensure that the following important Time (contract duration) related elements are included in the Contract Time Determination schedule:

- time required for the Contractor to plan the work and mobilize prior to starting physical work;
- preparation of critical submittals;
- review of critical submittals (by designer)*;
- procure/order materials;
- fabricate and deliver long-lead items;
- testing;
- commissioning;
- winter restrictions; and
- agency/utility/city restrictions.

** The Agencies will have a standard submittal review duration of 30 calendar days – with the exception of more complicated submittals (to be defined). These will have durations of 60 calendar days. This clause will help to properly plan the work and avoid a dispute (claim) for delays at the inception of the project.*

Near Term Mandate – related to planning construction packaging

The Agencies recognize that a critical aspect to the success of this ABP is the planning of:

1. right-of-way acquisitions;
2. permitting; and
3. environmental approvals.

The Agencies will initiate a formalized study of all bridges to be constructed near term to ensure that accomplishment of these elements has been accounted for properly. Commensurate changes will be made to the Program Budget and Program schedule, if necessary.

2.B.2 – Quality Control Plan - Contract Time Determination

Each ABP pre-bid construction schedule (*a.k.a. Contract Time Determination schedule*), for site specific construction contracts greater than \$1 Million will be prepared by a qualified construction scheduler and shall receive a QC review in accordance with the guidelines delineated herein. Reviews shall be performed and documented prior to delivering the schedule to the Agencies.

This will be added to all future Design Requirements (after Jan-09).

Quality Control Review Guidelines

- All schedule QC reviews shall be performed by a qualified professional other than the individual that developed the original schedule. This person is herein referred to as the Schedule Reviewer.
- The Schedule Reviewer shall use the following procedure as a guideline when performing schedule reviews.

Contract Scope Review

The Schedule Reviewer shall review the project documents for the work for which the pre-bid construction schedule was developed to become familiar with the major scope elements of the project. Documents to be reviewed include scope descriptions, plans, specifications, studies, correspondence, and any construction estimates that were developed. A check will be performed to verify that the major scope elements are included in the final schedule.

Schedule Format

The Reviewer shall make sure that the schedule has been developed in accordance with the requirements of the Agencies' contract scope and specifications describing the schedule requirements. The final Contract Time Determination Schedule will be provided to the Agencies in hard-copy form (*plots or 11x17*). The Reviewer shall also ensure that the schedule is developed in the format required by Agencies. The Reviewer shall make sure that:

- the Work Breakdown Structure is clear and logical;
- all contract bid items are incorporated;
- contract milestones are included and are clear and logical;
- graphics are clear and understandable;
- and electronic files are provided.

Basis Statement – List of Assumptions

The Reviewer will validate the basis statement and list of assumptions that have been prepared by the professional scheduler. The Reviewer shall compare the basis statement with the key scoping documents that were provided by the Engineer/Designer to ensure that the basis statement documents any major assumptions needed to address incomplete

or unclear design elements and recommendations to be addressed by the Designer/Engineer before the bid documents are finalized. These elements are necessary to fully assess the contract time. Examples include: work hour restrictions, limitations to access the work, temporary construction, submittal preparation and review time, crew basis, labor availability, right-of-way takings, contaminated soils, test pits, etc.

Summary Level Duration

The Reviewer will evaluate the summary level duration. For example, the Reviewer will check the overall square footage in a pre-bid construction schedule for a bridge deck replacement and compare it with the duration of similar bridge deck replacement projects using the most pertinent source available, e.g. other as-planned construction schedules, as-built construction schedules, etc.

Transition of Critical Data from the Construction Cost Estimate

On all site specific construction contracts greater than \$1 Million, the Agencies will require that all Contract Time Determination schedules are integrated with the construction cost estimate. The Reviewer will check to ensure that important data from the estimate has been incorporated into the schedule, including a consideration of the intended construction sequence, production rates, and labor hours/crew hours. Major differences between the durations in the cost estimate and those in the schedule on critical paths will be documented and/or provided with a Log-Note in the schedule file itself. The differences will need to be resolved prior to final approval to advertise the construction contract.

Critical Path

The Reviewer will perform a random “spot check” of 3 of the top 10 critical paths. The Reviewer will:

- follow the logic/sequence (to validate reasonableness of the successor/predecessor activities);
- check 50% of the durations on each these paths (to ensure that there is an adequate basis for them – crews/manhours, etc.);
- validate the reasonableness/basis of any significant lags that are used;
- ensure that calendars have been used properly; and
- ensure that the top critical path is a logical critical path for the project.

If there are significant problems with this spot check, or the checks in the two paragraphs that follow, the Reviewer will meet with the Scheduler to resolve findings and will continue to evaluate other paths and other aspects of the schedule.

Milestones and Access Restraints

The Reviewer will check to make sure that all Milestones and Access Restraints identified in the project documents are included in the schedule. The Reviewer will also perform a spot check of the Contract Milestones and Access Restraints. If there are fewer than 10 Contract Milestones/Access Restraints, the Reviewer will check each of the top paths to the Milestones for reasonableness and completeness. For those schedules

that contain more than 10 Milestones/Access Restraints, the Reviewer will validate no less than 10% of the Milestones/Access Restraints, in a similar fashion described above. The Reviewer will also ensure that the Milestones/Access Restraints have been inserted into the schedule software properly (i.e. activity type and zero duration).

Limitations of Operations – Construction Constraints

The Reviewer will check to make sure that all limitations of operations identified in the project documents are included in the schedule. The Reviewer will perform a spot check of the limitations of operations (specified in the contract documents) and/or constraints. If there are fewer than 10 of these restrictions, the Reviewer will check to ensure that each of the limitations has been adequately accounted for and that a reasonable successor has been included. For those schedules that contain more than 10 of these limitations, the Reviewer will validate no less than 30% of them, in a similar fashion described above.

Open Ends

The Reviewer will ensure the schedule submission contains no open ends. These are activities that are not assigned a successor and therefore contain excessive float values. The one exception to this is the final contract Milestone.

Other Important Elements

The Review will check to see that there is adequate time/duration to account for the reasonable time required for the Contractor to plan the work and mobilize prior to starting physical work and to complete the contract work. The Reviewer will validate that there is adequate time to:

- prepare and review critical submittals;
- procure/order materials;
- fabricate and deliver long-lead items;
- test;
- commission the project;
- accommodate winter restrictions; and
- accommodate agency/utility/city restrictions.

Contingency

The Reviewer will check to see that the pre-bid construction schedule contains an appropriate level of schedule contingency taking into account the stage of design, level of scope definition, and/or difficulty level of construction. The Reviewer will also ensure that the pre-bid construction basis statement contains a discussion/workup of any Time contingency used.

Disposition of Review Comments

The Reviewer shall record all of the comments developed during the review. The Reviewer shall then discuss each review comment with the Scheduler. The Scheduler

shall make adjustments to the pre-bid construction schedule based on the comments provided by the Reviewer, and shall provide a copy of the adjusted pre-bid construction schedule to the Reviewer. The Reviewer shall perform a final QC review of the pre-bid construction schedule to ensure that all adjustments have been incorporated into the final bid documents to be advertised.

Final QC Approval

Completion of the Schedule QC Review will be required prior to approving the contract documents for bid advertisement.

2.B.3 – Delivery Method – Use of Design-Build Contracts

Design-Bid-Build (DBB) has historically been the routine project delivery method used for MHD and DCR projects. It is commonly accepted in the design and construction industry that using the Design-Build (DB) project delivery method will result in a shorter project duration than if the DBB project delivery method is used, primarily because construction can begin prior to design completion.

The objective of this program will be to:

Implement the use of DB contracts, where appropriate, in order to minimize project schedules.

2.C - CONSTRUCTION SCHEDULE CONTROL

2.C.0 – Schedule Management During Construction

The Agencies recognize the significance of timely and accurate construction schedules. MassHighway has already begun to draft major enhancements to the schedule requirements of the Construction Contract Specifications. This section highlights additional enhancements that will be made and describes the manner in which the ABP Program Controls Group will assist in some of the future ABP projects.

In the sections that follow, the specifications, types of schedules, quality of the Contractor's Schedule Submittals, and other schedule-enhancement tools to be used on the Program will be explained. These requirements, concepts, and best practices, will be implemented in the project management procedures of the ABP.

Heavy/highway contractors may generate claims that are founded on the construction schedule of record (official schedule submittal). However, the construction schedule may not be maintained and the schedule requirements of the construction contract may not be enforced, and as a result, the Owner is left with little to present in defense of the claim. The Accelerated Bridge Program will implement several steps in the sections that follow to ensure that cases like this are minimized.

The construction schedule control program has been designed to:

1. Provide the Agencies' project managers with training sessions on best practices of construction schedule control (including Primavera or equivalent, CPM, Work-Session, Schedule Recovery, Critical Issues Reporting, Documentation, and Field Verification).
2. Develop and implement a standardized approach to construction schedule reviews and construction delay analysis.
3. Provide the Agencies' Schedule Control Manager with the necessary tools and resources to ensure that contractors are progressing diligently.
4. Ensure that the proper critical information flows from the field to the program level to ensure that informed program level decisions are made efficiently and effectively.
5. Ensure that proper documentation is provided to build the necessary audit trail in defense of time-related delay claims.

In order to perform this program, the following steps will be implemented:

1. A professional Construction Scheduler will be part of the new ABP Program Controls Group. Initially, one construction scheduler will be assigned to each District (5 MHD and 2 for DCR). The District Construction Engineer will be responsible for prioritizing the assignments of this construction scheduler (based upon critical need and benefit).
2. The Construction Schedulers will be responsible to:
 - Review and comment on the Contractor's baseline schedule;
 - Participate in contract status meetings;
 - Work with field inspectors to verify actual progress in the field – including construction resources planned vs. actual;
 - Generate ideas and studies to recover time delays;
 - Review, comment on, and present monthly status update submittals (from the Contractor);
 - Summarize and report on key schedule aspects of the individual projects to the upper program level;
 - Support Agencies' District Manager functions related to schedule reporting and presentations;
 - Prepare and present aspects of schedule delays and claims for Time; and
 - Provide schedule training to Agency inspectors and project managers.

3. ABP Project Managers and Schedulers will review critical information in the Contractor's Monthly Schedule and will routinely review, comment, and document the reason and basis for schedule changes.
4. The Agencies will update the current Schedule Specifications and internal procedures to promote the transparency and accountability required as part of the ABP Legislation.
5. The Agencies will also provide guidance and training to the ABP Project Managers/Resident Engineers on developing CPM schedule reviews, with Program integration (reporting and standardization) in mind. The Resident Engineers will continue to have a major responsibility of providing the primary review of each of the Contractor's monthly schedule updates.

Initial Guidance Recommendations:

After the issuance of a Notice-to-Proceed to the Contractor, each ABP site specific construction project will have its own unique project schedule. This schedule will detail the Contractor's work plan to complete all work on the project within the time specified in the Contract, including any interim milestones. There are multiple types of schedule submittals for each project, and multiple levels of schedule reviews that will need to be completed. Many of the required elements for each schedule submittal are detailed in contract documents such as the Standard Specifications and Special Provisions, while the process for performing the schedule reviews is detailed in the Quality Control Plan. The following are some examples of typical construction milestones:

Preservation Contracts

1. Contractor NTP
2. Mobilization
3. 25% complete
4. 50% complete
5. 75% complete
6. Substantial Completion
7. Final acceptance
8. DHD Certificate of Completion

Replacement Contracts

1. Contractor N.T.P.
2. Complete Structural Steel Shop Submittal & Drawings Submitted
3. Bridge Deck Demolition Complete
4. Substructure Replacement/Repair Complete (if applicable)
5. Structural Steel Replacement Complete
6. Final Bridge Deck Restored
7. Substantial Completion
8. Final Acceptance

9. DHD Certificate of Completion

Repair Contracts

1. Contractor N.T.P.
2. Complete Structural Steel Shop Submittal & Drawings Submitted
3. Complete Concrete Repair Submittal & Drawings Submitted
4. Bridge Deck Repair Complete (if applicable)
5. Structural Steel Repair Complete (if applicable)
6. Substructure Repair Complete (if applicable)
7. Substantial Completion
8. Final Acceptance
9. DHD Certificate of Completion

The actual schedule submittal requirements will be detailed in the contract documents in terms of frequency and items to be submitted. The typical project will include:

- preliminary schedule submittal (pre-NTP);
- a baseline schedule (initial work plan generated from the Contractor's bid plan); and
- schedule updates (typically monthly).

Depending on how the project progresses, there may also be revised schedules or even time-impact schedules on a case-by-case basis. The typical schedule submittal includes an electronic file, hardcopy plots and a schedule narrative. The electronic schedule file is the most important part of the schedule submittal as all information necessary to complete the schedule review can be found in the electronic file. A hard copy submittal (or even a PDF plot) should never be accepted in lieu of the electronic file as changes in the schedule may not be apparent when reviewing only a static print.

Schedule Narrative

A schedule narrative will be required for every schedule update the construction Contractor submits. This will detail the current status of the project, work performed in the past update period, and all changes to the schedule being proposed in the schedule submittal.

Preliminary Schedule

Review of the Preliminary Schedule Submittal typically is based on activities expected to be performed in the initial 90 days. The focus of this review is to see the general phasing of the project, planned performance on major contract milestones and overall time, initial

cost and resource loading. Generally a preliminary schedule review is not considered comprehensive but will provide an overview of the Contractor's approach to the project.

Baseline Schedule

The review of the Baseline Schedule submittal is the starting point against which all delay and production issues are measured. It is the comprehensive review of the Contractor's initial work plan to complete the project within the specified contract Time/duration. To assist in the review of the Baseline, the Agencies' Scheduler(s) will utilize the valuable information that is developed as part of the Contract Time Determination schedule (done by a professional scheduler during design). The Baseline Schedule will be compared against this document to see how the Contractor's planned approach to the project varies in planned production, sequencing and milestone completion. This will help to quickly identify problems (related to scope, intent, production, restrictions, etc.), and will be part of the documented review comments that the Agencies' Scheduler will develop.

All work scope contained in the Plans, Contract, Specifications and Special Provisions should be included in the Baseline Schedule along with a verification of the planned durations, schedule logic, and cost and resource loading as required. Once the Baseline Schedule is accepted, this submittal becomes the 'schedule of record' for the project until superseded. The Agencies' Specifications and Special Provisions will indicate the process for receiving a schedule submittal and the time allowed for review and response.

Monthly Schedule Updates

The Contractor's Monthly Schedule Update will be based on the most recent/past 'schedule of record'. Typical schedule updates include changes to actual progress and earned costs and resources, changes in schedule logic, added/deleted tasks, modified durations, etc., which will require review and acceptance prior to approval in the schedule. If a schedule update submittal is rejected, subsequent submittals will be based on the last accepted schedule by the Agencies until a new schedule of record is approved. Along with analysis of the technical schedule data, validation of as-built schedule data such as actual dates, percentage complete and resource expenditure is required. The validation of these items generally requires the assistance of project field staff or documentation. Therefore, the Agencies will make it a practice, on all site specific contracts over \$1 Million, to have the ABP Field Engineers reference the schedule activity identification # in their Daily Reports.

Revised Schedule

Revised Schedule Submittals require careful examination because the Contractor is proposing modifications to the approved work plan that may not be in accordance with the Contract documents. Revised Schedules used to validate alleged delay claims require a comprehensive review in addition to the normal Schedule Update. In this process, the Contractor is often seeking approval for work/delays that have not yet occurred. The Agencies' procedure will validate the proposed changes with a detailed review of the

Contractor's planned resources, sequencing, production rates, and potential impact to the contract substantial completion date.

2.C.2 – Integrated Program Schedule – From Contract To Program Level

An ABP Integrated Program Schedule will be developed and maintained to provide Agencies the ability to review and report on the overall health of the Program and standardize the management of multiple projects. This will be accomplished by requiring all ABP project schedules (from the Contractor and the Agencies' schedulers) to conform to a structure that is consistent in content and organization. This will allow reporting/statusing of the individual projects, as well as summary level reporting, for various breakdowns such as by city/district/region, fiscal year budget planning, or critical letting and construction milestones.

This program will also be developed with a procedure that promotes accountability at the contract level and transparency/visibility at the Agencies' executive level.

The objective of this portion of the Construction Schedule Control program will be to:

1. Ensure transparency in reporting project/contract level problems;
2. Provide a system of accountability at the project/contract level;
3. Ensure that program level decisions are made based on critical contract level considerations and status as a basis;
4. Develop an efficient mechanism to summarize and report on the overall ABP program health; and
5. Provide the ability to create multiple levels of reporting for ABP projects within the larger Program. The implementation of a consistent schedule structure will allow standardized routine reporting within the overall program, at the most detailed level.

Control/Accountability Aspects

The Agencies' Integrated Program Schedule will be generated with a formal procedure to ensure accountability at the project level. This will be done with the following steps:

1. The Contractor will provide weekly construction updates during the weekly construction status meeting held by the Agencies Resident Engineer/PM. The Agencies' Scheduler may attend and receive meeting minutes.

2. The contractor will provide monthly construction schedule updates in accordance with the requirements of the Agencies' scheduling specification.
3. Upon receiving the Contractor's schedule, the Resident Engineers (and/or District Schedulers) will review the schedule and provide comments in a written report to the ABP District Construction Engineer in a timely manner.
4. The ABP District Construction Engineer will promptly review the report and direct the District Scheduler on how to proceed with the monthly update of the Integrated Program Schedule.
5. The District Scheduler will routinely update the Integrated Program Schedule that will be utilized for summary level reporting. The Program Controls Group will be responsible to coordinate the information from the field, ensure consistency in reporting, and prepare the reporting information.

The following steps will be taken by Agencies to provide for successful Program level schedule implementation:

1. Develop Agencies' desired Program-level reporting for time, cost and resource status;
2. Determine the appropriate schedule structure and schedule loading requirements based on the Agencies' needs for the Program;
3. Refine the schedule specifications to be included in contract documents for each project within the Program; and
4. Create Program-level reports concurrently with the review of the individual project schedule updates on a monthly basis.

Organizational Requirements

The key to the Integrated Program Schedule is the creation and implementation of a specified work breakdown structure (WBS) that will become the basic organizational structure for each project schedule. Program level schedule report formats will also be developed. Each construction contract will include similar WBS and schedule loading requirements at bid advertising. Once the WBS has been implemented throughout the program, program status reports will be developed on a monthly basis coinciding with the monthly updates provided for each project. The Program-level reporting can be provided concurrently with or independently of the individual integrated project schedule update.

2.C.3 – Contract Specification Amendments

a. Contractor CPM Schedules

The schedules submitted by typical highway construction contractors are only as detailed as required by the contract specifications, and are often times diluted by the lack of enforcement of scheduling specification requirements. This has historically complicated the determination of delay causation, and has hindered the owner's ability to implement effective schedule control and recovery measures.

Accordingly, the Agencies will supplement the existing construction contract schedule specifications to require more comprehensive construction schedule submittals from construction contractors. The Agencies will require that all construction contractor schedules, for all site specific ABP projects greater than \$1 Million, be generated using the Critical Path Method (CPM), and Primavera Scheduling Software (or approved equivalent). This requirement will assure the foundation for adequate/defendable delay analysis, schedule control, and efficient reporting processes.

The Agencies' schedule specifications will be broken down into general, technical, and project-specific requirements. There will also be another level of schedule specification for sub-projects within larger projects.

General specifications will govern the basic information to be included in the CPM schedule. These will include, but not be limited to:

- maximum and minimum durations for tasks;
- working units (typically days but can be hours);
- working periods per day/week/month;
- cost and resource loading requirements;
- frequency of schedule submissions;
- definition of critical path and float time;
- procedures for time impacts and delay claims;
- procedures for preliminary schedules;
- baseline schedule requirements;
- revised and updated schedule requirements; and
- procedures for schedule reviews and responses.

The technical specifications will govern requirements related to the scheduling application. These include, but are not limited to:

- the type of scheduling software;
- the format of schedule submittals;
- schedule calculation methods;
- and organization and layout;
- requirements for work breakdown structure (WBS); and

- activity coding.

Project-specific specifications will vary among projects. These include, but are not limited to:

- weather considerations,
- work limitations and working periods,
- construction sequence, and
- contract milestones.

Scheduling Specification enforcement is as important as comprehensive contract requirements. The Standard Specification will not apply to every project in the Program. It will be necessary to develop guidance on CPM schedule Special Provisions that will allow Agencies to be responsive to various levels of project complexity and cost. Some of those recommendations have been previously addressed in this Report.

b. Primavera Software (or Equivalent)

The Agencies will mandate that all Contractors of site specific contracts greater than \$1 Million utilize Primavera scheduling software (or equivalent) to control both cost and schedule of the Accelerated Bridge Program in the most effective manner and to provide the a uniform reporting platform. This type of software is endorsed by many state departments of transportation, is the software most commonly used by the local Contractors, and is the preferred choice of local claims consultants that work for state agencies.

The main objectives of this requirement will be to:

1. Ensure effective, standardized ABP schedule reporting.
2. Ensure an effective, standardized approach in analyzing delays and reviewing contractor schedules.
3. Provide for the most efficient/timely mechanism to share schedule update information.
4. Provide the most efficient and effective mechanism to summarize program status (project “roll-up”) and manage multiple projects in an accelerated fashion.
5. Implement a schedule control system that is most commonly accepted for civil construction projects by local contractors, claims consultants, professional schedulers, and other DOTs alike.

In order to implement this control measure, the following steps will be taken:

1. An initial determination of the current Agencies' staff capabilities will be made along with current Agencies' schedule procedures.
2. An Implementation Plan for the Agencies will be developed. It will include training of Agencies' staff and the acquisition and installation of selected software workstations.
3. There will be a period of training for all Agency staff working with project schedules. The training course typically includes:
 - Basic terminology and scheduling techniques;
 - Effective operation of the software scheduling application;
 - Development of a baseline schedule;
 - Schedule review techniques for baseline and updated schedules; and
 - Basic time impact analysis for claims issues.
4. The Implementation Plan and training course will be coordinated with any changes in Schedule Specifications so that the most current schedule requirements will be reinforced with the Agencies' staff.

c. Cost and Resource Loaded Schedules

The Agencies will amend their construction scheduling specifications to require a cost and resource loaded construction schedule for every site specific construction contract that is valued at over \$1 Million. This specification adjustment will be made in early 2009.

The main goal of this portion of the program control will be to develop a more effective and industry accepted method to:

- Monitor contractor performance;
- Provide for a more effective means of evaluating options to recover Time;
- Provide a more comprehensive/accurate evaluation of contractor claims for Time, ensuring a better evaluation of the true cause and ownership of delays; and
- Provide effective change management within each contract and the overall Accelerated Bridge Program.

The following measures will be part of the construction schedule control program:

Cost & Resource Loaded Schedules (for all site specific contracts > \$1Million):

- Each schedule activity will have an assigned cost consistent with the value of work to be installed and will accurately reflect the bid value of the activity payment item. Example: Lump Sum Bridge Structure 999,000, one payment

item, has 120 construction activities, 15 procurement (material purchase) activities, 25 critical submittal activities. Each activity will be assigned a cost that added together equals the total bid item value.

- Each schedule activity will also have an assigned crew composition by man-hour consistent with the value of work to be installed and reflective of the bid value of the payment item.
- Unless approved by the Agencies' Project Managers, each activity will not be more than 20 days duration or less than 5 days duration. This will help to ensure the proper cost break-down.
- As part of the Baseline Schedule review by the Agencies' Scheduler, a review of the distribution of cost will be performed. This will be done to ensure that the Contactor has not "unbalanced" the value of work in the schedule. Unbalancing occurs when there is an unreasonable amount of money requested at the beginning of the construction schedule, or when the cost loaded for schedule activities is grossly different from its reasonable value.
- The Contractor will be informed of the intent of this requirement in the scheduling specifications. The following or similar language will be included:

"This project requires an integrated cost/schedule controls program that the Contractor shall comply with from Contract award until final completion of all Work. The Contractor is advised that its schedules and reports as specified herein will be an integral part of the Agencies' management program. The Contactor's schedules will be used by the Agencies to monitor project progress, plan the level of effort by its own work forces and consultants, and as a critical decision making tool. Accordingly, the Contractor shall ensure that it complies fully with the requirements specified herein and that its schedules are both timely and accurate throughout the life of the project. The Contractor's Schedules shall be used by the Agencies and the Contractor for the following purposes as well as any other purpose where the issue of Time is relevant:

1. To communicate the Contractor's current plan for performing and completing the Work.
2. To identify Work items and paths that are critical to the timely completion of the Work.
3. To identify upcoming activities on the critical path(s).
4. To evaluate the best course of action for recovering schedule delays.
5. As the basis of progress payments to the Contractor.

6. As the basis for analyzing the Time impact of changes in the Work.
7. To identify when submittals will be submitted by the Contractor for the Agencies' review.
8. To aid in prioritizing the Agencies' review of submittals.
9. To document the actual progress of the Work.
10. To evaluate resource requirements of the Contractor and the Agencies.
11. To aid in integrating the Work with the operational requirements of the Agencies.
12. To facilitate efforts to complete the Work in a timely manner."

EXAMPLE RESOURCE LOADED SCHEDULE (see description above)

Activity ID	Activity Description	Cal ID	Orig Dur	J	AUG	SEP	2006 OCT	NOV	DEC	JAN	FEB
DR280	Remove exist sign/panels/light @ barricade	1	3				■ Remove exist sign/panels/light @ barricade				
DR282	Demo existing wall/remove (barricade) @ Platform	1	25				■ Demo existing wall/remove (barricade) @				
DR242	Cut shear key Col 9.5..17	1	8				■ Cut shear key Col 9.5..17				
DR227	Demo platform brick edge Col 16..P5 (E/W)	7	2				■ Demo platform brick edge Col 16..P5 (E/W)				
DR121	Demo invert slab Sta 6+99 - 7+29	1	5				■ Demo invert slab Sta 6+99 - 7+29				
DR250	Cut shear key Col 17..22	1	8				■ Cut shear key Col 17..22				
DR126	Resources						■ Demo roof slab/girder (col 25.6-27.7)				
DR127	- + 0211.000						■ Demo invert slab Sta 7+29 to 7+54				
DR146	Resource	0211.000	LABORER	320EXCAV	OPERATOR		■ Complete demo roof slab/girder (col				
DR147	Cost Acct/Cater	0211.000					■ Demo invert slab Sta 7+54 to 7+80				
SS136A	Driving						■ Submit: Demoliti				
DR148	Curve						■ Roof demo finishes/prep platfor				
NH1466	Units per day	0.00	24.00	1.00	8.00		■ Demo ex arch crown @ drain pi				
DR240	Budgeted quant	0.00	120.00	5.00	40.00		■ Sawcut platform CL (east/				
DR270	Res Lag/Durati	0	0	0	0		■ Sawcut platform CL				
	Percent comple										

Activity DR121 shows (above):

5 day duration

There are 3 laborers in the crew – working 8 hrs/day = 24 laborer hours/day

5 days x 24 laborer hours/day = 120 laborer hours for the planned activity to demo the invert.

If, the Contractors "actual" are 80 hours, and the activity is on the critical path, questions need to be asked and answers need to be documented.

EXAMPLE COST LOADED SCHEDULE

Activity ID	Activity Description	Cal ID	Orig Dur	J	AUG	SEP	2006 OCT	NOV	DEC
DR280	Remove exist sign/panels/light @ barricade	1	3				■ Remove exist sign/panels/light @ barricade		
DR282	Demo existing wall/remove (barricade) @ Platform	1	25				■ Demo existing wall/remove (barricade) @ Platform		
DR242	Cut shear key Col 9.5..17	1	8				■ Cut shear key Col 9.5..17		
DR227	Demo platform brick edge Col 16..P5 (E/W)	7	2				■ Demo platform brick edge Col 16..P5 (E/W)		
DR121	Demo invert slab Sta 6+99 - 7+29	1	5				■ Demo invert slab Sta 6+99 - 7+29		
DR250	Cut shear key Col 17..22	1	8				■ Cut shear key Col 17..22		
DR126	Demo roof slab/girder (col 25.6-27.7)						■ Demo roof slab/girder (col 25.6-27.7)		
DR127	Demo invert slab Sta 7+29 to 7+54						■ Demo invert slab Sta 7+29 to 7+54		
DR146	Complete demo roof slab/girder (col 27.7-7+81)						■ Complete demo roof slab/girder (col 27.7-7+81)		
DR147	Demo invert slab Sta 7+54 to 7+80						■ Demo invert slab Sta 7+54 to 7+80		
SS136A	Submit: Demolition Plans - Maverick Station						■ Submit: Demolition Plans - Maverick Station		
DR148	Roof demo finishes/prep platform						■ Roof demo finishes/prep platform		
NH1466	Demo ex arch crown @ drain pipe sta 4+09						■ Demo ex arch crown @ drain pipe sta 4+09		
DR240	Sawcut platform CL (east/west) Col 10..16						■ Sawcut platform CL (east/west) Col 10..16		
DR270	Sawcut platform CL (east/west) Col 16..22						■ Sawcut platform CL (east/west) Col 16..22		
SB440	Demo & remove existing Substation/equipment (E)						■ Demo & remove existing Substation/equipment (E)		
MD108	Demo (see resource) tunnel roof @ TS 4						■ Demo (see resource) tunnel roof @ TS 4		

Cost	
Resource	0211.000
Cost Acct/Cate	0211.000
Driving	☐
Curve	
Budgeted cost	28334.00
Actual this period	0.00
Actual to date	0.00
Percent expended	0.0
Percent complete	
Earned value	0.00
Cost to complete	28334.00
At completion	28334.00
Variance	0.00

Budget	Codes	Constr	Cost	Custom	Dat
ID	DR121	Demo invert slab Sta 6+99 - 7+29			

Activity DR121 shows, the same activity in the resource loaded example above shows, the budgeted cost to be \$28,334.

Payment – Earned Value

The cost loaded schedule will also be utilized for payment of the Lump Sum Bridge Payment items. See below for further description of this cost and schedule control measure.

d. Schedule Narrative

To help manage multiple contracts in an accelerated fashion, the Agencies' scheduling specification will include a requirement for the contractor to provide a comprehensive schedule report each month. This report will include a narrative with the following components, and is designed to provide the Project Managers with a streamlined overview of the contractor's monthly update submission:

1. Each narrative shall list the Activities on each Critical Path and compare Early Dates and Late Dates.
2. Each narrative shall include (a) the Contractor's site management plan (e.g., lay down, staging, traffic, parking, etc.), (b) the use of construction equipment and resources, (c) basis and assumptions for critical activity durations and logic, (d) compliance with winter weather requirements, and (e) any shifts, non-Business Days and multiple calendars applied to the Activities.
3. For each Progress Schedule Submittal, the narrative shall recap progress and days gained or lost versus the previous Progress Schedule, describe changes in resources to be used on remaining Work and identify Delays, their extent and causes. For Progress Schedule Submittals, each narrative

shall also itemize changes in Activities and logic ties caused by each Change Order, schedule recovery plans and grouping of related Contractor-initiated revisions.

4. Each narrative shall certify that the Contractor has not been delayed, as of the closing date, by any act, error or omission of the Agencies, or their Designer/Engineer, except as otherwise specifically stated in the narrative or identified in a claim submitted in accordance with the general conditions of the Contract. Any determination by the Agencies will be binding on the Contractor if the Contractor fails to do so.

e. Delay Provisions

In order to assist the Agencies with the management of delays, the schedule specification will include a clear, detailed description of what the Contractor needs to provide in order to prove delay and receive a Time extension.

The extension of Contract Time will be considered only if the Contractor demonstrates via the timely submittal of a detailed schedule analysis by using the Contemporaneous Window Analysis methodology or other similar methodology acceptable to the Agencies. The analysis shall include: a) a detailed narrative which clearly describes the events causing the delay and the resulting impacts to the project schedule; b) documentation substantiating and supporting the delay; c) a detailed CPM schedule (both electronic and hard copies) clearly delineating the delay; d) a matrix showing delays caused by the Authority, delays caused by the Contractor, delays caused by any third party and any force majeure delays; and e) any additional information reasonably requested by Agencies, including the Contractor's daily reports, in order to enable the Agencies to perform a timely and informed analysis of the request for extension of Contract Time.

The following or similar language will also be added to the end of the scheduling specification to ensure that proper attention to the scheduling requirements is provided by the Contractor.

MEASUREMENT AND PAYMENT

A. MEASUREMENT

1. A fixed price not to exceed \$_____.00 will be made to reimburse the contractor for CPM Scheduling. Payment will be made under Item No. _____, CPM Scheduling, to the Contractor.

B. PAYMENT

1. Fifteen percent (15%) of the fixed price for CPM Scheduling will be made upon return to the Contractor of the CPM Construction Plan Baseline Schedule Submittal as "Re-submittal Not Required" (As-Planned Schedule).

2. The remaining (85%) will be pro-rated in equal amounts on each subsequent application for payment upon the Agency's receipt and approval of the monthly CPM updates.

f. Contractor Payment – Earned Value

The Agencies will require every Contractor on site specific contracts greater than \$1 Million to comply with an Earned Value Management Program for payment of all Lump Sum Payment items. This specification requirement will be included in all ABP construction contracts that are planned to be bid in early 2009 and those thereafter.

The main goal is to implement an effective, industry accepted method to:

- monitor contractor performance;
- ensure a reasonable distribution of payment for work actually installed;
- assist in evaluating trends in a timely fashion, allowing for earlier corrective action; and
- assist in ensuring that the contractor schedule submissions are accurate and timely.

The following measure will be part of the construction schedule control program:

Payment – Earned Value (for Lump Sum Payment Items only).

The cost-loaded schedule will also be utilized for payment purposes. Each month, as part of the Contractor requisition for payment, the activities within the Contractor schedule will be statused (percentage complete), and the percentage complete will serve as the value of work that will be paid to the Contractor (less retainage). This Earned Value cost control will be required on each contract to ensure that the Contractor does not receive more money than the value of work actually installed.

In so doing, physical progress will be measured in dollars. This schedule performance allows for a secondary manner of monitoring the actual progress and will assist in cost control throughout the contract duration. It will also assist in getting Contractors to update and utilize their construction schedules.

Contractor Payment Example:

Activity DR121 (graphic below):

Shows a planned cost of \$28,334 for the demolition of the invert. It also shows that it is part of bid item 0211.000 DEMOLITION LUMP SUM.

Using the Agencies Earned Value payment procedure, if the contractor has completed 3 days of the 5 day demolition activity, and has 2 days of work remaining (verified by an Agencies inspector) at the time of the payment requisition closing date, the Contractor would be entitled to receive \$17,000 $((28,334 \times (3/5)))$.

EARNED VALUE EXAMPLE:

Activity ID	Activity Description	Cal ID	Orig Dur	2006	J	AUG	SEP	OCT	NOV	DEC
DR280	Remove exist sign/panels/light @ barricade	1	3							
DR282	Demo existing wall/remove (barricade) @ Platform	1	25							
DR242	Cut shear key Col 9.5..17	1	8							
DR227	Demo platform brick edge Col 16..P5 (E/W)	7	2							
DR121	Demo invert slab Sta 6+99 - 7+29	1	5							
DR250	Cut shear key Col 17..22	1	8							
DR126	Demo roof slab/girder (col 25.6-27.7)									
DR127	Demo invert slab Sta 7+29 to 7+54									
DR146	Complete demo roof slab/girder (col 27.7-7+81)									
DR147	Demo invert slab Sta 7+54 to 7+80									
SS136A	Submit: Demolition Plans - Maverick Station									
DR148	Roof demo finishes/prep platform									
NH1466	Demo ex arch crown @ drain pipe sta 4+09									
DR240	Sawcut platform CL (east/west) Col 10..16									
DR270	Sawcut platform CL (east/west) Col 16..22									
SB440	Demo & remove existing Substation/equipment (E)									
NP1466	Demo (non revenue) tunnel roof @ TS 4									

Cost		0211.000	
Resource	0211.000		
Cost Acct/Cater	0211.000		
Driving	☐		
Curve			
Budgeted cost	28334.00		
Actual this period	0.00		
Actual to date	0.00		
Percent expended	0.0		
Percent complete			
Earned value	0.00		
Cost to complete	28334.00		
At completion	28334.00		
Variance	0.00		

Budget	Codes	Constr	Cost	Custom	Dat
ID	DR121	Demo invert slab Sta 6+99 - 7+29			

Note: Unit Priced Payment items will be paid in accordance with the procedures already in place (prior to Nov-08).

2.C.2 – Contract Schedule Review Meetings

On site specific contracts greater than \$1 Million, the Agencies will implement regular internal Senior Project Management Contract Schedule Review meetings. These meetings will be implemented at the district level and critical information will be reported to the Program level, through the Program Controls Group. The Program Controls Group will be responsible to track and prioritize the Critical Action Items (including submittal reviews, RFI responses, shop drawing approval, contractor deadlines, responses from outside agencies, force account deadlines).

The main objective of these meetings will be to:

1. Generate a formalized senior management review process that allows for program level priorities to be evaluated and acted on as efficiently as possible.
2. Evaluate cost and schedule controls – these meetings will be primarily focused on identifying schedule related concerns and working out a swift course of action (see section 1.B for Internal Control Meetings).

3. Develop action items to recover delays (and/or costs) and monitor status at subsequent meetings.

The Senior Management Contract Schedule Review Meeting will be implemented as follows:

CRITICAL ACTION ITEMS MEETING:

(for CONSTRUCTION contracts):

1. Twice per month, each ABP Resident Engineer, on site specific contracts greater than \$1Million, will provide a CRITICAL ACTION ITEMS REPORT – listing each contract’s critical issues.
2. This report will be generated with the following considerations:
 - a. Identify the issue, potential delay, problem;
 - b. Relate to the current contract schedule (activity ID and criticality – total float);
 - c. Identify the person assigned to resolve the issue;
 - d. Identify a NEED DATE for resolution (again relating it to the current schedule); and
 - e. Assign a priority for resolution (vs other critical action items on the same contract).
3. Each District/Field Engineer/Manager (with the assistance of the new Cost/Schedule Engineer) will be responsible to assemble all monthly Critical Action Items and review/approve the final selection of the most important items to address in the report to the Agencies’ senior program managers.
4. Following the District Engineer/Managers’ finalization of the reports, the reports will be sent to the Senior Program Management Team (including Chief Engineer and Program Controls Director).
5. After a limited number of review days to be established, a Senior Management meeting will be held. The District Managers will present each of the contracts that they maintain, providing an overview of each contract with particular attention to problem areas. Each Engineer/Manager will follow up with recommended courses of action and address questions and concerns from the Senior Management Team.
6. Action items to recover costs and/or delays will be generated and statused at subsequent meetings.

Note: See section on CRITICAL ACTIONS MEETINGS for Schedule Control.

2.C.3 – Schedule Recovery Work-Sessions

The Agencies will initiate a formal Schedule Recovery Work-session program. This program will be utilized on contracts with poor schedule performance and whenever the critical path has delayed the completion of work by more than 20 days.

The main goal of this program is to help explore options to RECOVER LOST TIME FOR DELAYS.

The following is a listing of the key principles that will be utilized:

- The Contractor is informed that cooperation in this matter will help to expedite resolution;
- Posturing, from all parties, is to be put aside;
- The Contractor's latest schedule is to be analyzed and tested for "what-if" options;
- The session must be attended by "the people that are actually doing the work,"
- Requires Commitment from Senior Members of the Agencies, the Contractor, and the Designer;
- If multiple contractors and sub-contractors are involved, they all need to be represented;
- A log will be created of all of the schedule changes to validate the recovery plan and in any future Time Entitlement Analysis; and
- "Commercial issues" are to be sorted out at a later date.

2.C.4 – Quality Control Plan – Construction Schedule Review

The complexities and contractual implications associated with the Contractor Schedule review require the assistance of qualified construction schedulers.

The Quality Control Plan (QCP) defines the goals for meeting the Agencies' expectations regarding the analysis and reporting of CPM schedule submittals. These goals fall into three categories: (1) **agency goals** for the project; (2) **quality assurance** for schedule review and (3) **quality control** of the schedule review.

The **agency goals** for the project include providing a quality deliverable, within budget and within the time considerations determined by the Contract or Specifications. The process for determining these goals is a collaborative effort between the Agencies' Project Managers and the Schedule Reviewer. It provides transparency among Agencies' expectations, the review process, and production of the schedule deliverable.

Quality assurance for the schedule review process focuses on the process of producing the deliverable. **Quality control** of the schedule review involves review of the work being performed. Quality control involves the Agencies' management and scheduler staff

and includes oversight of the process, completion of review checklists, external reporting, and internal approvals.

During the Agencies' schedule review, the quality control process will be enforced as prescribed in the QCP through completion of the final deliverable for each schedule submittal. Quality assurance will occur over the length of the Program with review cycles also as determined by the QCP.

The objective of this program will be as follows:

Develop a quality control plan that provides a defined process to achieve ABP goals through the deliverables.

As an initial step toward implementing this program, the ABP schedule managers will review the following checklist for Baseline Schedule Reviews:

Milestones, Access Restraints and Access Provisions Review

- Does the schedule model Milestones and Access Constraints as described in the specification?
- Are Milestone Constraint dates included and correct?
- Are Access Constraint dates included and correct?
- Are Access Constraints, along with seasonal limitations, represented correctly as described in the Access Provisions?
- Are there additional Access Constraints or Milestones identified in the schedule but not in the specifications?
- Is the site, with its phases, Access Restraints and Provisions constructible?
- Are there early completions of Milestones? If so, and the Milestone date does not change, there will just be positive float in the schedule.

Scope of Work review

- Is the full scope of work modeled into the schedule?
- Is the level of schedule detail consistent with the contract and project requirements?
- Does the schedule detail the full scope of work, and sufficient time, including : Contractor & Subcontractors - major submittals, shop drawings, major procurement items, major fabrication and delivery items, equipment installation, punch list, O & M items, and testing. Owner – permits & licenses; review of major submittals (generally 30 days); construction inspection; testing, start up, turn over and commissioning activities; and time for final Owner agency work and inspections.
- Is the Work Breakdown Structure acceptable?
- Are activity durations, in work days with calendars, identified?
- Are activity duration times reasonable? Rule of thumb: >5 days, < 30 days.
- Are durations for fabrication and delivery reasonable?
- Are durations consistent with expected manpower usage, relative to the cost, resource and narrative information available?

Logic review

- Are there open ended activities?
- Are the activity relationships logical? (Foundations after excavation)
- Are seasonal impacts addressed?
- Can the activity durations be supported by reasonable production rates?
- Are relationships other than a FS, 0 lag reasonable? Review to ensure that logic is modeled not to promote sequestered float.

Float Review

- Are lag relationships and lag durations reasonable?
- Are activity durations inflated?
- Are all logic ties dependent on one another?
- Review the logic and analyze to determine if the critical path is flowing through the higher probable problem areas of the project. If it is, is there a work around to eliminate this work plan?
- Is the percentage of critical and near critical activities reasonable? Generally 15 – 25% should be expected.

Critical Path Review

- Do the critical paths make sense?
- Do the critical path and near critical path activities reflect significant work being accomplished and not inconsequential work that can be done concurrently with critical path work?
- Are there float suppression techniques used? (incorrect constraint dates, inflated durations, incorrect logic).

Narrative Review

- Does the narrative describe in detail how the contractor plans on utilizing its resources, including subcontractor crews and equipment, to support its approach to constructing the project?

Cost Review (For projects that are cost loaded)

- Are all unit price and lump sum price items represented in the schedule?
- Do the activity costs, for each payment item, aggregately equal the bid amount?
- Do the activity costs, for the filed subcontractors, aggregately equal the bid amount?
- Are the payment item costs and filed subcontractor costs front end loaded?
- Are there sufficient costs allocated to all O & M and testing activities?

Resource Review (For projects that are resource loaded or used with narrative info.)

- Are labor and equipment resources adequate for the work planned?
- Relative to durations, are crew sizes and production rates too high or too low?
- Will the resources be adequate to support production rates? (Cross check with narrative)
- Are the resources specified unrealistic?

- Are there too many resources identified for the work being planned at that time frame, due to: confined space limitations or other work being done concurrently, posing adjacent contractor problems or subcontractor conflict (coordination may or may not be a reasonable plan)?
- If logic ties are used to represent planned resource usage, but are not necessarily dependent on one another, convince the contractor to resource load these activities. If the logic is not due to means and methods but is based on a preferential logical work approach, any delay claims emanating there from should be rejected.

2.C.5 – Schedule Contingency

Important Note: The Schedule dates provided for individual projects thus far are conceptual. They have not been generated using any standard practices for Contract Time Determination. These will be validated following the completion of the 75% Construction Cost Estimate.

ADDITIONAL STUDY – for **construction** contingency validation

An ABP Program budget exposure has been identified to monitor a budgetary risk associated with the potential cost increases normally associated with highway/bridge construction in the Northeast (winter impacts and common delay issues).

To validate the 15% Construction Cost contingency implemented, after some construction contracts progress, the Program will perform a study of the past bridge project completion costs and timeframes. This will be a comparison of the bridges that have completed over the past 3 years – and will be designed to compare the bid value vs. the actual Cost-at-Completion to determine a reasonable percentage for which to budget. If the findings conclude that there needs to be a budget allotment of much greater than the 15% previously added, then the Agencies will adjust the program and Budget Control in a reasonable manner. This will also become part of the legislative reporting Program Performance Indicators.

2.C.6 – Schedule Review Impacts

The recommendations, direction, and comments provided in the Agencies' review of schedule submittals will be made by an experienced, professional construction controls/construction scheduler. Such reviews will consider the contract documents, accepted construction practices, the overall goals of the ABP, the potential monetary impacts of changing the Contractor's plan, as well as project-specific plans, specifications, and special provisions.

The objective of this portion of the construction schedule control program will be as follows:

To avoid costly consequence of actions, or inactions, by the Agencies' project management team as part of the schedule reviews process.

Near term mandate – related to planning construction packaging

1. The Agencies recognize that one of the most critical aspects of this Program will be the sufficiency of resources during the early stages of the Program in order to successfully advertise the early planned bridge packages (see also Section 4. Staffing of this Report).
2. The Agencies recognize that another critical aspect is the planning of right-of-way acquisitions, permitting, and environmental approval process. The Agencies will initiate a formalized study to evaluate the near term bridges in order to confirm the duration for these three critical approvals. If it is later determined that the current planning duration assumptions are inadequate, necessary changes will be made to the Program Budget and Program schedule.

Additional Examples that will be incorporated into the Agencies' guidance for schedule management: The following is a list of common schedule review comments that can adversely impact project schedules and/or costs. The Agencies will provide guidance to the project management team members that will help to ensure that these critical aspects are dealt with consistently and efficiently.

1. *Comments that affect Contract Time and/or project milestones*
2. *Comments that have the potential to change the Contractor's accepted work operations (Means and Methods)*
3. *Comments associated with the Contractor's planned production rates*
4. *Comments that are contradictory to the Contract Documents*
5. *Comments affecting schedule calculation methods*
6. *Comments that add or delete work*
7. *Comments related to third party or off-site issues*

SECTION 3 - CONSTRUCTION QUALITY

3.A.1 - Construction Quality Control & Quality Assurance

Formal construction quality control and quality assurance programs and procedures must be in place in order to manage and control the quality of construction. Historically, it has been the industry standard to require the construction contractor to provide construction quality control, while the owner typically provides quality assurance oversight to ensure that the contractor is effectively following and implementing its quality control plan. It is also important to ensure that the construction contractor's quality control requirements and responsibilities are clearly defined in each construction contract.

A methodology which has been proven effective over time is to include construction quality control requirements (construction contractor inspection and testing parameters) in the construction contract documents, and require the contractor to submit a formal construction quality control (QC) plan which delineates the detailed inspection and testing measures it will implement for each element of the work, to ensure that all work installed conforms to the requirements of the contract documents. This is treated as a formal submittal which gives the owner the opportunity to review and comment on the plan to ensure that it is comprehensive and effective.

The owner then develops and implements its own internal quality assurance (QA) oversight plan to ensure that the contractor is complying with the inspection and testing requirements contained in its approved QC plan. Owner QA oversight measures typically include performing its own inspections and tests at appropriate frequencies to verify that the contractor is properly and effectively implementing its QC plan, and that the plan is in fact ensuring that the work of the project conforms to the requirements of the contract documents. Frequencies and levels of QA oversight inspections and tests will vary from project to project, depending on the complexity of the project and the observed effectiveness of the contractor's QC plan and efforts.

The objectives of this program will be as follows:

The Agencies will develop and implement a formal Construction Quality Control & Quality Assurance program that will be followed on all Accelerated Bridge Program construction contracts. All ABP construction contracts will contain a standardized Contractor Quality Control specification, tailored to the specific requirements and complexities of each individual construction contract. The Agencies will also develop a standard Construction Quality Assurance program and approach that will be implemented on all ABP construction contracts.

To achieve these objectives, the following steps will be implemented as the core guideline:

1. The Agencies will review their existing Contractor Quality Control specifications for construction contracts, make warranted improvements, and tailor the specifications to specifically address the requirements of Accelerated Bridge Program. These specifications will be included in all ABP construction contracts.
2. The Agencies will hold Contractor Quality Control refresher training sessions with all ABP construction personnel, to ensure that all construction personnel are intimately familiar with the requirements of the ABP Contractor Quality Control construction contract specifications.
3. The Agencies will hold construction Contractor Quality Control training sessions with all construction contractors prior to their performing work on ABP construction Contracts. The purpose of this training will be to ensure that all construction contractors performing work on ABP construction contracts understand the requirements of the Contractor Quality Control specifications.
4. The Agencies will review their existing Construction Quality Assurance procedures, make warranted improvements, and tailor the procedures to specifically address the requirements of the Accelerated Bridge Program.
5. The Agencies will hold Construction Quality Assurance refresher training sessions with all ABP construction personnel, to ensure that all construction personnel are intimately familiar with the requirements of the ABP Construction Quality Assurance procedures.

SECTION 4 – IMPLEMENTATION

4.A.1 – Near Term Recommendations/Priorities

Over the next 6 months, the Agencies will focus on the following aspects of the Program Controls plan:

1. Finalize and implement Staffing Plan.
2. Implement Software Control Systems as highlighted in this report.
3. Implement contractual changes.
4. Establish training program.
5. Establish Task Forces (Early priorities commonly problematic for start of construction contracts).

ABP Staffing for Project Controls

Mission

In order to develop, implement, and maintain effective project controls on the Accelerated Bridge Program, it is necessary to establish a dedicated Project Controls Group. The purpose of the Project Controls Group is to provide preliminary evaluations of each individual project cost and schedule, develop an overall program cost and schedule, and constantly monitor and report on the programs progress with regards to cost and schedule.

This organizational arrangement will allow Project Controls Group to focus its efforts solely on its control and reporting functions, and report project and Program status in an objective and factual manner.

Organizational Structure

Overall Project Controls Group

The Project Controls Group will be headed by a Project Controls Director. The Project Controls Director will be responsible for developing, implementing, and managing effective, comprehensive cost and schedule control and reporting systems for the Accelerated Bridge Program, the Agencies and the Oversight Council.

Schedule Control Organization

All schedule control and reporting efforts will be headed by a Schedule Control Supervisor who will be responsible for the daily management of a comprehensive schedule control and reporting system. Schedule Analysts will be responsible for

developing, monitoring, reviewing, analyzing, and reporting on project level (design and construction) schedules, as well as the overall program level schedule. It is anticipated that schedule analysts will be assigned both in MassHighway Boston, MassHighway District Offices and the DCR Office and Field Offices.

The number of Schedule Analysts will be determined in conjunction with the finalization of each individual project's schedule review. It is expected that during Years One and Two of the program, the Schedule Control Group will consist of the Schedule Control Supervisor and three Schedule Analysts. The Schedule team will develop and implement the schedule control and reporting system. This will require a program level schedule, project level schedule templates, and early project level schedules and reports. As more ABP projects become active, additional Schedule Analysts will be added on an as needed basis. As the volume of Program contracts escalate, the number of Schedule Analysts will be commensurate with the level of effort required to maintain effective control of and reporting on all project schedules and the Program level schedule. Early estimations on staffing needs will be completed following the acceptance of the Project Controls Report. Neither Agency currently supports a program controls effort that is commensurate with the level of effort proposed for the Accelerated Bridge Program. Throughout the early years of the Program, the Project Controls Plan will be augmented with a staff of contract employees or consultants with the requisite expertise in schedule and cost management. However, the Agencies intend to transition over time that labor intensive effort, from consultants to an "in-house" staffing capability.

In addition, it is expected that project control initiatives or applications successfully implemented as part of the Accelerated Bridge Program will then be applied to each Agency's future statewide programs.

Cost Control Organization

All cost control and reporting efforts will be headed by a Cost Control Supervisor, who will report directly to the Project Controls Manager. The Cost Control Supervisor will be responsible for developing, implementing, and managing an effective, comprehensive cost control and reporting system for the Accelerated Bridge Program, and for managing the efforts of Cost Analysts. A group of Cost Analysts will work under the Cost Control Supervisor. Cost Analysts will be responsible for developing, monitoring, reviewing, analyzing, and reporting on project level (design and construction) costs, as well as overall program level costs.

The number of Cost Analysts will be determined in conjunction with the finalization of each individual project's schedule review. It is envisioned that at the beginning of the program, the Cost Control Organization will consist of the Cost Control Supervisor and two Cost Analysts who will together develop and implement the program level cost control and reporting system. Additional duties will include cost control and reporting templates, and early project cost control reports. As more ABP projects become active, additional Cost Analysts will be added on an as needed basis. The number of Cost Analysts will be commensurate with the level of effort required to maintain effective control of and reporting on all project costs and program level costs.